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

Date: 2/4/21

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 2/4/21 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.

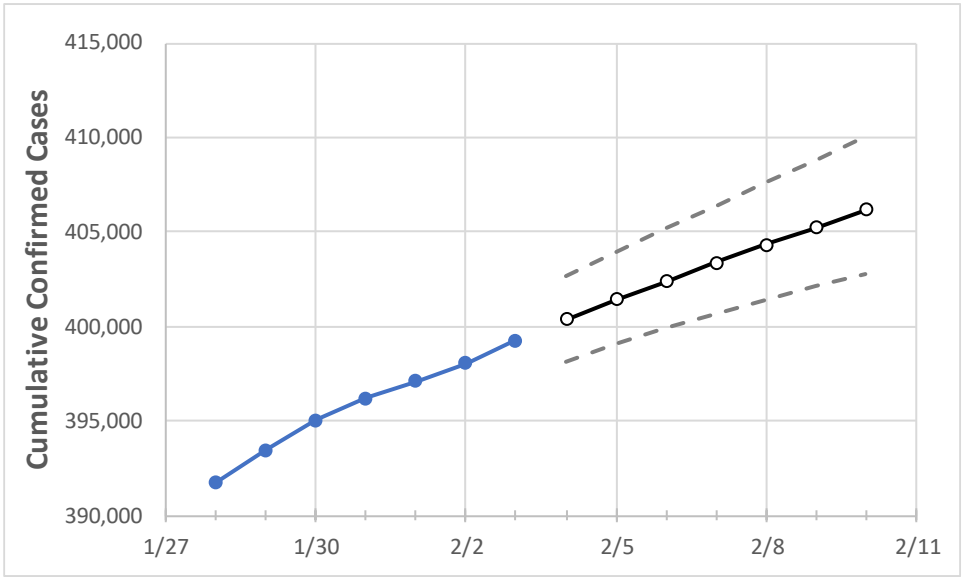
IEM's Modeling Lead

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:						
	1/31	2/1	2/2	2/3	2/4	2/5	2/6	2/7	2/8	2/9	2/10
Colorado	396,185	397,101	398,037	399,267	400,353	401,405	402,396	403,363	404,317	405,246	406,151

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:						
	1/31	2/1	2/2	2/3	2/4	2/5	2/6	2/7	2/8	2/9	2/10
Adams	45,735	45,807	45,871	45,982	46,078	46,168	46,257	46,343	46,427	46,508	46,585
Arapahoe	45,027	45,154	45,243	45,359	45,484	45,604	45,719	45,833	45,941	46,045	46,147
Boulder	17,224	17,263	17,298	17,369	17,425	17,480	17,533	17,585	17,635	17,685	17,734
Denver	55,734	55,835	55,910	56,051	56,174	56,294	56,407	56,520	56,625	56,725	56,828
Douglas	18,920	19,029	19,096	19,205	19,279	19,353	19,425	19,493	19,561	19,627	19,695
Eagle	4,390	4,402	4,427	4,479	4,506	4,533	4,558	4,584	4,610	4,636	4,662
El Paso	47,777	47,842	47,933	48,056	48,155	48,250	48,340	48,433	48,518	48,602	48,682
Gunnison	1,054	1,056	1,061	1,069	1,077	1,084	1,091	1,098	1,105	1,111	1,118
Jefferson	34,593	34,665	34,737	34,827	34,919	35,004	35,089	35,171	35,250	35,327	35,401
Larimer	18,065	18,115	18,160	18,246	18,312	18,377	18,440	18,500	18,561	18,620	18,678
Pueblo	14,339	14,353	14,367	14,381	14,397	14,412	14,428	14,443	14,457	14,471	14,485
Weld	23,586	23,640	23,779	23,841	23,906	23,971	24,032	24,092	24,151	24,207	24,264

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:		
	1/31	2/1	2/2	2/3	2/5	2/7	2/9
Adams	45,735	45,807	45,871	45,982	46,168 (9,234) [2,216] {1,108}	46,343 (9,269) [2,224] {1,112}	46,508 (9,302) [2,232] {1,116}
Arapahoe	45,027	45,154	45,243	45,359	45,604 (9,121) [2,189] {1,094}	45,833 (9,167) [2,200] {1,100}	46,045 (9,209) [2,210] {1,105}
Boulder	17,224	17,263	17,298	17,369	17,480 (3,496) [839] {420}	17,585 (3,517) [844] {422}	17,685 (3,537) [849] {424}
Denver	55,734	55,835	55,910	56,051	56,294 (11,259) [2,702] {1,351}	56,520 (11,304) [2,713] {1,356}	56,725 (11,345) [2,723] {1,361}
Douglas	18,920	19,029	19,096	19,205	19,353 (3,871) [929] {464}	19,493 (3,899) [936] {468}	19,627 (3,925) [942] {471}
Eagle	4,390	4,402	4,427	4,479	4,533 (907) [218] {109}	4,584 (917) [220] {110}	4,636 (927) [223] {111}
El Paso	47,777	47,842	47,933	48,056	48,250 (9,650) [2,316] {1,158}	48,433 (9,687) [2,325] {1,162}	48,602 (9,720) [2,333] {1,166}
Gunnison	1,054	1,056	1,061	1,069	1,084 (217) [52] {26}	1,098 (220) [53] {26}	1,111 (222) [53] {27}
Jefferson	34,593	34,665	34,737	34,827	35,004 (7,001) [1,680] {840}	35,171 (7,034) [1,688] {844}	35,327 (7,065) [1,696] {848}
Larimer	18,065	18,115	18,160	18,246	18,377 (3,675) [882] {441}	18,500 (3,700) [888] {444}	18,620 (3,724) [894] {447}
Pueblo	14,339	14,353	14,367	14,381	14,412 (2,882) [692] {346}	14,443 (2,889) [693] {347}	14,471 (2,894) [695] {347}
Weld	23,586	23,640	23,779	23,841	23,971 (4,794) [1,151] {575}	24,092 (4,818) [1,156] {578}	24,207 (4,841) [1,162] {581}

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.