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

Date: 3/22/21

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 3/22/21 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.

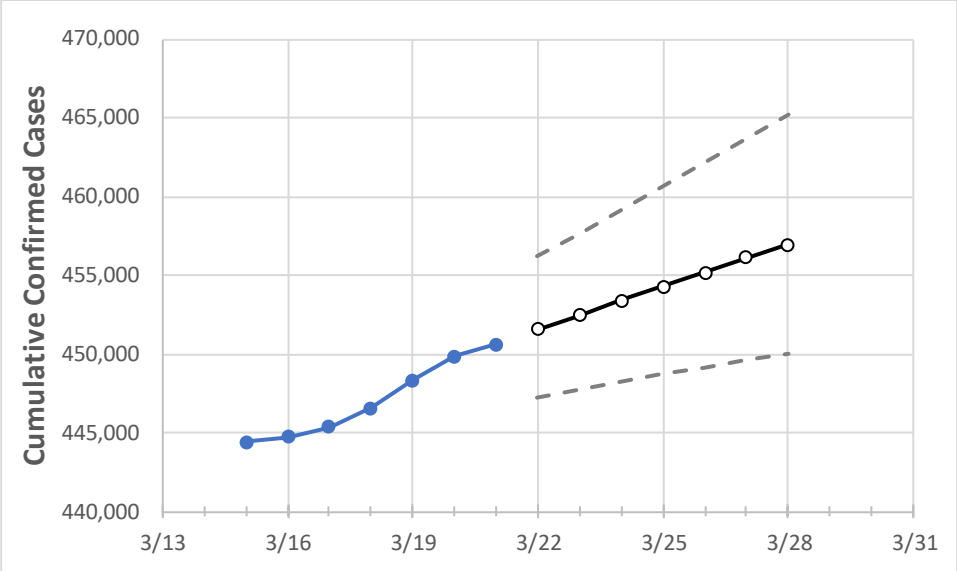
IEM's Modeling Lead

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:						
	3/18	3/19	3/20	3/21	3/22	3/23	3/24	3/25	3/26	3/27	3/28
Colorado	446,580	448,362	449,828	450,630	451,581	452,479	453,383	454,271	455,188	456,112	456,969

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:						
	3/18	3/19	3/20	3/21	3/22	3/23	3/24	3/25	3/26	3/27	3/28
Adams	50,118	50,287	50,396	50,463	50,541	50,619	50,698	50,774	50,848	50,924	51,001
Arapahoe	50,342	50,543	50,687	50,778	50,874	50,971	51,069	51,159	51,251	51,344	51,437
Boulder	19,743	19,854	19,921	19,969	20,024	20,080	20,137	20,196	20,255	20,315	20,374
Denver	62,050	62,254	62,475	62,578	62,705	62,833	62,958	63,088	63,210	63,337	63,462
Douglas	22,630	22,753	22,850	22,913	22,973	23,031	23,088	23,144	23,197	23,253	23,305
Eagle	5,468	5,489	5,497	5,523	5,541	5,559	5,576	5,594	5,610	5,627	5,644
El Paso	54,427	54,682	54,889	54,988	55,114	55,243	55,369	55,496	55,624	55,753	55,874
Gunnison	1,225	1,225	1,225	1,225	1,227	1,229	1,230	1,232	1,234	1,236	1,237
Jefferson	38,966	39,152	39,306	39,384	39,479	39,573	39,666	39,757	39,854	39,948	40,042
Larimer	21,139	21,298	21,400	21,443	21,495	21,548	21,600	21,651	21,704	21,753	21,806
Pueblo	15,427	15,453	15,479	15,495	15,515	15,536	15,557	15,578	15,598	15,618	15,639
Weld	26,584	26,701	26,800	26,852	26,911	26,971	27,030	27,091	27,151	27,209	27,269

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:		
	3/18	3/19	3/20	3/21	3/23	3/25	3/27
Adams	50,118	50,287	50,396	50,463	50,619 (10,124) [2,430] {1,215}	50,774 (10,155) [2,437] {1,219}	50,924 (10,185) [2,444] {1,222}
Arapahoe	50,342	50,543	50,687	50,778	50,971 (10,194) [2,447] {1,223}	51,159 (10,232) [2,456] {1,228}	51,344 (10,269) [2,465] {1,232}
Boulder	19,743	19,854	19,921	19,969	20,080 (4,016) [964] {482}	20,196 (4,039) [969] {485}	20,315 (4,063) [975] {488}
Denver	62,050	62,254	62,475	62,578	62,833 (12,567) [3,016] {1,508}	63,088 (12,618) [3,028] {1,514}	63,337 (12,667) [3,040] {1,520}
Douglas	22,630	22,753	22,850	22,913	23,031 (4,606) [1,105] {553}	23,144 (4,629) [1,111] {555}	23,253 (4,651) [1,116] {558}
Eagle	5,468	5,489	5,497	5,523	5,559 (1,112) [267] {133}	5,594 (1,119) [268] {134}	5,627 (1,125) [270] {135}
El Paso	54,427	54,682	54,889	54,988	55,243 (11,049) [2,652] {1,326}	55,496 (11,099) [2,664] {1,332}	55,753 (11,151) [2,676] {1,338}
Gunnison	1,225	1,225	1,225	1,225	1,229 (246) [59] {29}	1,232 (246) [59] {30}	1,236 (247) [59] {30}
Jefferson	38,966	39,152	39,306	39,384	39,573 (7,915) [1,900] {950}	39,757 (7,951) [1,908] {954}	39,948 (7,990) [1,918] {959}
Larimer	21,139	21,298	21,400	21,443	21,548 (4,310) [1,034] {517}	21,651 (4,330) [1,039] {520}	21,753 (4,351) [1,044] {522}
Pueblo	15,427	15,453	15,479	15,495	15,536 (3,107) [746] {373}	15,578 (3,116) [748] {374}	15,618 (3,124) [750] {375}
Weld	26,584	26,701	26,800	26,852	26,971 (5,394) [1,295] {647}	27,091 (5,418) [1,300] {650}	27,209 (5,442) [1,306] {653}

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.