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

Date: 4/19/21

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 4/19/21 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.

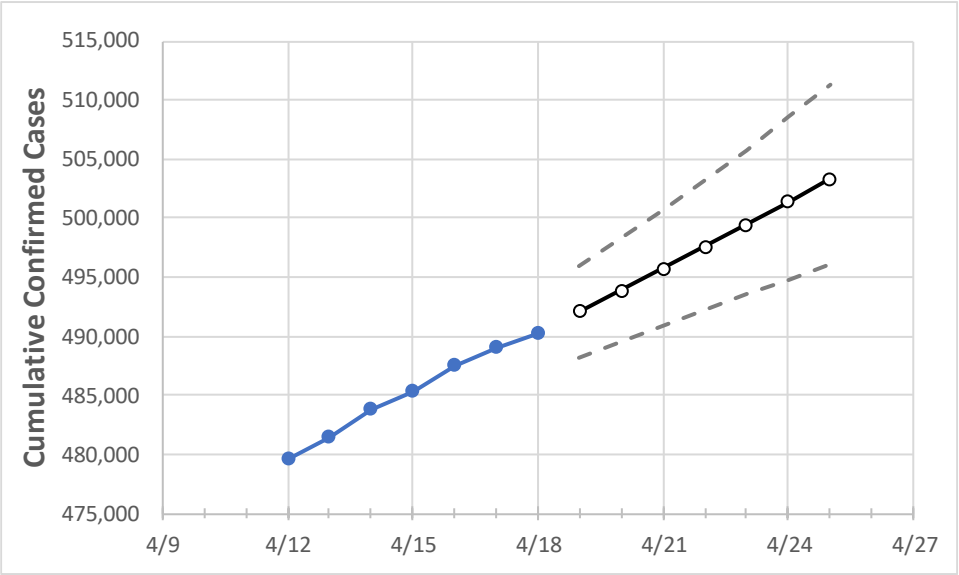
IEM's Modeling Lead

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:						
	4/15	4/16	4/17	4/18	4/19	4/20	4/21	4/22	4/23	4/24	4/25
Colorado	485,318	487,578	489,028	490,289	492,075	493,892	495,710	497,584	499,487	501,409	503,304

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:						
	4/15	4/16	4/17	4/18	4/19	4/20	4/21	4/22	4/23	4/24	4/25
Adams	53,483	53,703	53,863	54,024	54,207	54,391	54,586	54,788	54,989	55,206	55,422
Arapahoe	54,530	54,795	54,947	55,108	55,326	55,547	55,775	56,008	56,246	56,490	56,741
Boulder	21,772	21,897	21,968	22,007	22,080	22,151	22,222	22,296	22,367	22,439	22,506
Denver	67,641	67,865	68,034	68,188	68,443	68,700	68,969	69,248	69,528	69,819	70,112
Douglas	25,799	26,014	26,128	26,223	26,386	26,556	26,731	26,913	27,092	27,283	27,477
Eagle	6,018	6,036	6,045	6,055	6,071	6,087	6,102	6,118	6,134	6,149	6,165
El Paso	59,979	60,309	60,485	60,646	60,879	61,117	61,357	61,606	61,852	62,105	62,351
Gunnison	1,288	1,292	1,296	1,298	1,301	1,304	1,308	1,311	1,315	1,319	1,323
Jefferson	42,496	42,738	42,881	43,044	43,226	43,408	43,597	43,792	43,994	44,199	44,408
Larimer	23,929	24,062	24,165	24,239	24,346	24,456	24,565	24,673	24,784	24,894	25,001
Pueblo	16,640	16,716	16,788	16,825	16,893	16,964	17,039	17,117	17,193	17,274	17,357
Weld	28,819	28,967	29,076	29,172	29,283	29,394	29,508	29,623	29,740	29,859	29,984

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:		
	4/15	4/16	4/17	4/18	4/20	4/22	4/24
Adams	53,483	53,703	53,863	54,024	54,391 (10,878) [2,611] {1,305}	54,788 (10,958) [2,630] {1,315}	55,206 (11,041) [2,650] {1,325}
Arapahoe	54,530	54,795	54,947	55,108	55,547 (11,109) [2,666] {1,333}	56,008 (11,202) [2,688] {1,344}	56,490 (11,298) [2,712] {1,356}
Boulder	21,772	21,897	21,968	22,007	22,151 (4,430) [1,063] {532}	22,296 (4,459) [1,070] {535}	22,439 (4,488) [1,077] {539}
Denver	67,641	67,865	68,034	68,188	68,700 (13,740) [3,298] {1,649}	69,248 (13,850) [3,324] {1,662}	69,819 (13,964) [3,351] {1,676}
Douglas	25,799	26,014	26,128	26,223	26,556 (5,311) [1,275] {637}	26,913 (5,383) [1,292] {646}	27,283 (5,457) [1,310] {655}
Eagle	6,018	6,036	6,045	6,055	6,087 (1,217) [292] {146}	6,118 (1,224) [294] {147}	6,149 (1,230) [295] {148}
El Paso	59,979	60,309	60,485	60,646	61,117 (12,223) [2,934] {1,467}	61,606 (12,321) [2,957] {1,479}	62,105 (12,421) [2,981] {1,491}
Gunnison	1,288	1,292	1,296	1,298	1,304 (261) [63] {31}	1,311 (262) [63] {31}	1,319 (264) [63] {32}
Jefferson	42,496	42,738	42,881	43,044	43,408 (8,682) [2,084] {1,042}	43,792 (8,758) [2,102] {1,051}	44,199 (8,840) [2,122] {1,061}
Larimer	23,929	24,062	24,165	24,239	24,456 (4,891) [1,174] {587}	24,673 (4,935) [1,184] {592}	24,894 (4,979) [1,195] {597}
Pueblo	16,640	16,716	16,788	16,825	16,964 (3,393) [814] {407}	17,117 (3,423) [822] {411}	17,274 (3,455) [829] {415}
Weld	28,819	28,967	29,076	29,172	29,394 (5,879) [1,411] {705}	29,623 (5,925) [1,422] {711}	29,859 (5,972) [1,433] {717}

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.