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

Date: 4/21/21

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 4/21/21 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.

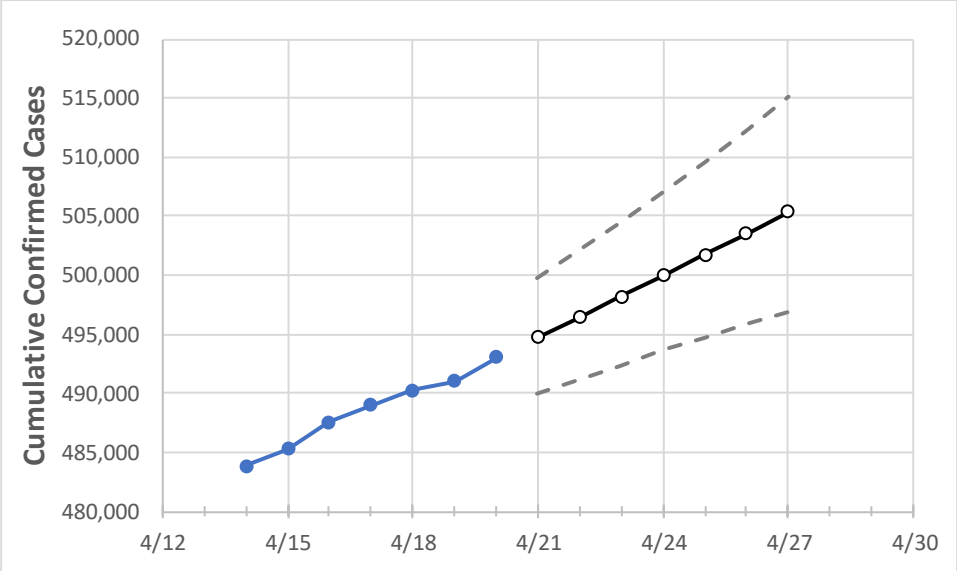
IEM's Modeling Lead

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:						
	4/17	4/18	4/19	4/20	4/21	4/22	4/23	4/24	4/25	4/26	4/27
Colorado	489,028	490,289	491,066	493,029	494,743	496,451	498,184	499,932	501,739	503,539	505,342

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:						
	4/17	4/18	4/19	4/20	4/21	4/22	4/23	4/24	4/25	4/26	4/27
Adams	53,863	54,024	54,131	54,321	54,501	54,687	54,873	55,060	55,256	55,457	55,662
Arapahoe	54,947	55,108	55,192	55,432	55,636	55,841	56,053	56,265	56,486	56,710	56,941
Boulder	21,968	22,007	22,041	22,128	22,197	22,265	22,332	22,398	22,465	22,529	22,594
Denver	68,034	68,188	68,255	68,518	68,744	68,980	69,216	69,446	69,682	69,915	70,161
Douglas	26,128	26,223	26,271	26,379	26,523	26,673	26,824	26,977	27,128	27,286	27,445
Eagle	6,045	6,055	6,064	6,089	6,105	6,120	6,135	6,151	6,166	6,180	6,195
El Paso	60,485	60,646	60,762	61,137	61,383	61,626	61,869	62,122	62,375	62,628	62,885
Gunnison	1,296	1,298	1,299	1,303	1,306	1,309	1,312	1,315	1,319	1,322	1,326
Jefferson	42,881	43,044	43,107	43,304	43,474	43,644	43,814	43,990	44,171	44,349	44,535
Larimer	24,165	24,239	24,304	24,409	24,509	24,607	24,706	24,805	24,907	25,004	25,106
Pueblo	16,788	16,825	16,867	16,921	16,985	17,050	17,116	17,184	17,253	17,322	17,391
Weld	29,076	29,172	29,233	29,344	29,449	29,557	29,665	29,774	29,885	29,997	30,112

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:		
	4/17	4/18	4/19	4/20	4/22	4/24	4/26
Adams	53,863	54,024	54,131	54,321	54,687 (10,937) [2,625] {1,312}	55,060 (11,012) [2,643] {1,321}	55,457 (11,091) [2,662] {1,331}
Arapahoe	54,947	55,108	55,192	55,432	55,841 (11,168) [2,680] {1,340}	56,265 (11,253) [2,701] {1,350}	56,710 (11,342) [2,722] {1,361}
Boulder	21,968	22,007	22,041	22,128	22,265 (4,453) [1,069] {534}	22,398 (4,480) [1,075] {538}	22,529 (4,506) [1,081] {541}
Denver	68,034	68,188	68,255	68,518	68,980 (13,796) [3,311] {1,656}	69,446 (13,889) [3,333] {1,667}	69,915 (13,983) [3,356] {1,678}
Douglas	26,128	26,223	26,271	26,379	26,673 (5,335) [1,280] {640}	26,977 (5,395) [1,295] {647}	27,286 (5,457) [1,310] {655}
Eagle	6,045	6,055	6,064	6,089	6,120 (1,224) [294] {147}	6,151 (1,230) [295] {148}	6,180 (1,236) [297] {148}
El Paso	60,485	60,646	60,762	61,137	61,626 (12,325) [2,958] {1,479}	62,122 (12,424) [2,982] {1,491}	62,628 (12,526) [3,006] {1,503}
Gunnison	1,296	1,298	1,299	1,303	1,309 (262) [63] {31}	1,315 (263) [63] {32}	1,322 (264) [63] {32}
Jefferson	42,881	43,044	43,107	43,304	43,644 (8,729) [2,095] {1,047}	43,990 (8,798) [2,112] {1,056}	44,349 (8,870) [2,129] {1,064}
Larimer	24,165	24,239	24,304	24,409	24,607 (4,921) [1,181] {591}	24,805 (4,961) [1,191] {595}	25,004 (5,001) [1,200] {600}
Pueblo	16,788	16,825	16,867	16,921	17,050 (3,410) [818] {409}	17,184 (3,437) [825] {412}	17,322 (3,464) [831] {416}
Weld	29,076	29,172	29,233	29,344	29,557 (5,911) [1,419] {709}	29,774 (5,955) [1,429] {715}	29,997 (5,999) [1,440] {720}

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.