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

Date: 3/29/22

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 3/29/22 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.

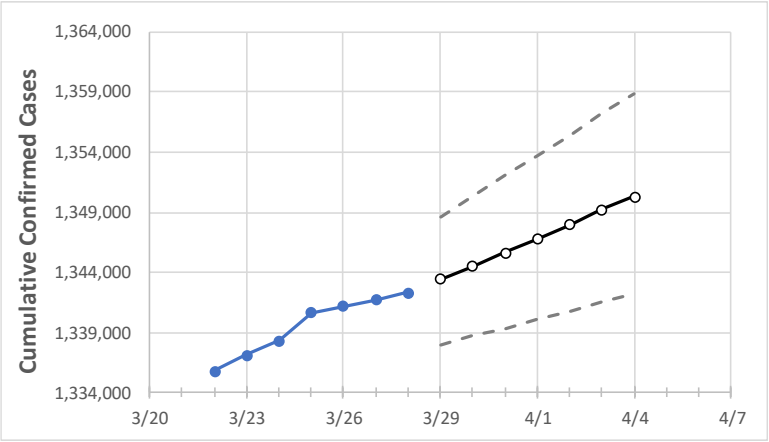
IEM's Modeling Lead

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:						
	3/25	3/26	3/27	3/28	3/29	3/30	3/31	4/1	4/2	4/3	4/4
Colorado	1,340,626	1,341,185	1,341,744	1,342,303	1,343,421	1,344,513	1,345,615	1,346,810	1,347,958	1,349,208	1,350,301

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:						
	3/25	3/26	3/27	3/28	3/29	3/30	3/31	4/1	4/2	4/3	4/4
Adams	130,582	130,622	130,663	130,703	130,789	130,873	130,958	131,044	131,127	131,215	131,302
Arapahoe	149,058	149,112	149,166	149,220	149,330	149,441	149,553	149,666	149,781	149,899	150,016
Boulder	62,453	62,495	62,536	62,578	62,674	62,770	62,868	62,967	63,069	63,172	63,279
Denver	167,406	167,497	167,588	167,679	167,817	167,963	168,100	168,249	168,393	168,545	168,688
Douglas	76,714	76,742	76,769	76,797	76,870	76,942	77,018	77,090	77,164	77,244	77,320
Eagle	15,821	15,825	15,828	15,832	15,840	15,848	15,856	15,864	15,872	15,881	15,889
El Paso	182,333	182,399	182,465	182,531	182,652	182,777	182,900	183,018	183,141	183,269	183,382
Gunnison	3,340	3,341	3,341	3,342	3,344	3,346	3,348	3,351	3,353	3,355	3,357
Jefferson	120,759	120,836	120,914	120,991	121,125	121,259	121,396	121,532	121,670	121,809	121,954
Larimer	75,877	75,922	75,966	76,011	76,107	76,204	76,300	76,393	76,492	76,593	76,691
Pueblo	45,456	45,466	45,477	45,487	45,533	45,579	45,621	45,665	45,706	45,751	45,791
Weld	82,109	82,141	82,174	82,206	82,281	82,356	82,433	82,508	82,585	82,665	82,743

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:		
	3/25	3/26	3/27	3/28	3/30	4/1	4/3
Adams	130,582	130,622	130,663	130,703	130,873 (26,175) [6,282] {3,141}	131,044 (26,209) [6,290] {3,145}	131,215 (26,243) [6,298] {3,149}
Arapahoe	149,058	149,112	149,166	149,220	149,441 (29,888) [7,173] {3,587}	149,666 (29,933) [7,184] {3,592}	149,899 (29,980) [7,195] {3,598}
Boulder	62,453	62,495	62,536	62,578	62,770 (12,554) [3,013] {1,506}	62,967 (12,593) [3,022] {1,511}	63,172 (12,634) [3,032] {1,516}
Denver	167,406	167,497	167,588	167,679	167,963 (33,593) [8,062] {4,031}	168,249 (33,650) [8,076] {4,038}	168,545 (33,709) [8,090] {4,045}
Douglas	76,714	76,742	76,769	76,797	76,942 (15,388) [3,693] {1,847}	77,090 (15,418) [3,700] {1,850}	77,244 (15,449) [3,708] {1,854}
Eagle	15,821	15,825	15,828	15,832	15,848 (3,170) [761] {380}	15,864 (3,173) [761] {381}	15,881 (3,176) [762] {381}
El Paso	182,333	182,399	182,465	182,531	182,777 (36,555) [8,773] {4,387}	183,018 (36,604) [8,785] {4,392}	183,269 (36,654) [8,797] {4,398}
Gunnison	3,340	3,341	3,341	3,342	3,346 (669) [161] {80}	3,351 (670) [161] {80}	3,355 (671) [161] {81}
Jefferson	120,759	120,836	120,914	120,991	121,259 (24,252) [5,820] {2,910}	121,532 (24,306) [5,834] {2,917}	121,809 (24,362) [5,847] {2,923}
Larimer	75,877	75,922	75,966	76,011	76,204 (15,241) [3,658] {1,829}	76,393 (15,279) [3,667] {1,833}	76,593 (15,319) [3,676] {1,838}
Pueblo	45,456	45,466	45,477	45,487	45,579 (9,116) [2,188] {1,094}	45,665 (9,133) [2,192] {1,096}	45,751 (9,150) [2,196] {1,098}
Weld	82,109	82,141	82,174	82,206	82,356 (16,471) [3,953] {1,977}	82,508 (16,502) [3,960] {1,980}	82,665 (16,533) [3,968] {1,984}

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.