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

Date: 2/25/22

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 2/25/22 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.

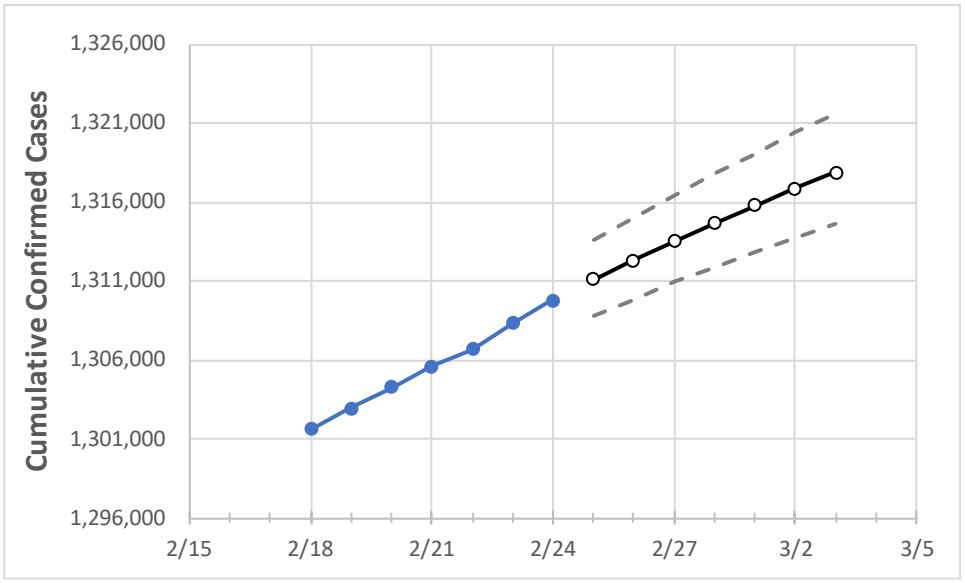
IEM's Modeling Lead

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:						
	2/21	2/22	2/23	2/24	2/25	2/26	2/27	2/28	3/1	3/2	3/3
Colorado	1,305,623	1,306,684	1,308,351	1,309,778	1,311,079	1,312,315	1,313,506	1,314,648	1,315,801	1,316,886	1,317,898

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:						
	2/21	2/22	2/23	2/24	2/25	2/26	2/27	2/28	3/1	3/2	3/3
Adams	128,159	128,222	128,332	128,432	128,521	128,608	128,687	128,769	128,843	128,915	128,988
Arapahoe	145,929	146,058	146,220	146,332	146,453	146,572	146,685	146,799	146,906	147,010	147,114
Boulder	60,300	60,363	60,410	60,501	60,565	60,627	60,688	60,746	60,802	60,857	60,907
Denver	163,725	163,872	164,032	164,171	164,308	164,442	164,569	164,698	164,822	164,942	165,058
Douglas	74,926	74,994	75,095	75,156	75,228	75,297	75,368	75,432	75,497	75,561	75,622
Eagle	15,554	15,567	15,593	15,592	15,604	15,615	15,626	15,637	15,647	15,658	15,668
El Paso	177,626	177,738	177,990	178,214	178,400	178,578	178,745	178,915	179,071	179,225	179,377
Gunnison	3,186	3,185	3,189	3,224	3,230	3,235	3,240	3,245	3,251	3,256	3,261
Jefferson	117,392	117,533	117,685	117,804	117,937	118,070	118,201	118,328	118,450	118,574	118,693
Larimer	73,090	73,164	73,297	73,422	73,527	73,627	73,725	73,821	73,914	74,009	74,094
Pueblo	43,719	43,732	43,801	43,865	43,911	43,957	44,001	44,045	44,087	44,127	44,165
Weld	79,940	79,995	80,084	80,196	80,269	80,336	80,403	80,466	80,527	80,587	80,642

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:		
	2/21	2/22	2/23	2/24	2/26	2/28	3/2
Adams	128,159	128,222	128,332	128,432	128,608 (25,722) [6,173] {3,087}	128,769 (25,754) [6,181] {3,090}	128,915 (25,783) [6,188] {3,094}
Arapahoe	145,929	146,058	146,220	146,332	146,572 (29,314) [7,035] {3,518}	146,799 (29,360) [7,046] {3,523}	147,010 (29,402) [7,056] {3,528}
Boulder	60,300	60,363	60,410	60,501	60,627 (12,125) [2,910] {1,455}	60,746 (12,149) [2,916] {1,458}	60,857 (12,171) [2,921] {1,461}
Denver	163,725	163,872	164,032	164,171	164,442 (32,888) [7,893] {3,947}	164,698 (32,940) [7,906] {3,953}	164,942 (32,988) [7,917] {3,959}
Douglas	74,926	74,994	75,095	75,156	75,297 (15,059) [3,614] {1,807}	75,432 (15,086) [3,621] {1,810}	75,561 (15,112) [3,627] {1,813}
Eagle	15,554	15,567	15,593	15,592	15,615 (3,123) [750] {375}	15,637 (3,127) [751] {375}	15,658 (3,132) [752] {376}
El Paso	177,626	177,738	177,990	178,214	178,578 (35,716) [8,572] {4,286}	178,915 (35,783) [8,588] {4,294}	179,225 (35,845) [8,603] {4,301}
Gunnison	3,186	3,185	3,189	3,224	3,235 (647) [155] {78}	3,245 (649) [156] {78}	3,256 (651) [156] {78}
Jefferson	117,392	117,533	117,685	117,804	118,070 (23,614) [5,667] {2,834}	118,328 (23,666) [5,680] {2,840}	118,574 (23,715) [5,692] {2,846}
Larimer	73,090	73,164	73,297	73,422	73,627 (14,725) [3,534] {1,767}	73,821 (14,764) [3,543] {1,772}	74,009 (14,802) [3,552] {1,776}
Pueblo	43,719	43,732	43,801	43,865	43,957 (8,791) [2,110] {1,055}	44,045 (8,809) [2,114] {1,057}	44,127 (8,825) [2,118] {1,059}
Weld	79,940	79,995	80,084	80,196	80,336 (16,067) [3,856] {1,928}	80,466 (16,093) [3,862] {1,931}	80,587 (16,117) [3,868] {1,934}

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.