IEM's AI Modeling: Short-term COVID-19 Projections
Date: 7/9/21

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 7/9/21 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
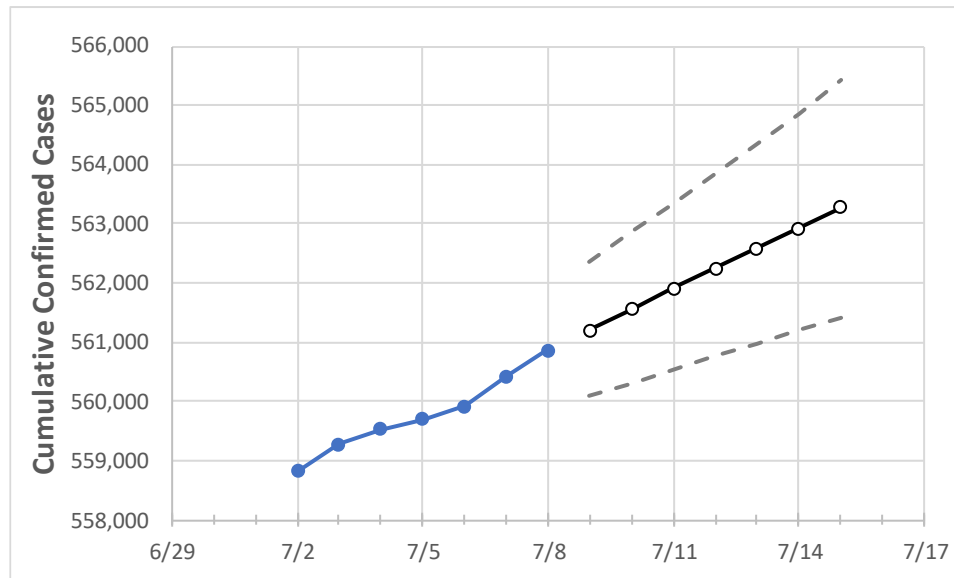
	Actual Confirmed Cases On:				Projected Cases For:						
	7/5	7/6	7/7	7/8	7/9	7/10	7/11	7/12	7/13	7/14	7/15
Colorado	559,704	559,921	560,419	560,860	561,208	561,563	561,910	562,240	562,589	562,925	563,275

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:						
	7/5	7/6	7/7	7/8	7/9	7/10	7/11	7/12	7/13	7/14	7/15
Adams	61,047	61,063	61,129	61,148	61,176	61,203	61,230	61,259	61,285	61,313	61,339
Arapahoe	62,977	62,987	63,033	63,072	63,105	63,137	63,169	63,201	63,231	63,262	63,294
Boulder	24,054	24,059	24,087	24,083	24,098	24,112	24,128	24,143	24,159	24,175	24,191
Denver	74,504	74,519	74,555	74,583	74,607	74,630	74,654	74,676	74,698	74,722	74,745
Douglas	30,602	30,613	30,636	30,652	30,664	30,676	30,687	30,698	30,708	30,717	30,726
Eagle	6,369	6,369	6,372	6,374	6,376	6,377	6,379	6,380	6,382	6,384	6,385
El Paso	73,673	73,725	73,813	73,908	73,969	74,030	74,091	74,151	74,211	74,271	74,330
Gunnison	1,403	1,403	1,404	1,405	1,406	1,408	1,409	1,410	1,412	1,413	1,414
Jefferson	49,017	49,023	49,055	49,081	49,100	49,121	49,140	49,159	49,178	49,196	49,214
Larimer	27,831	27,845	27,872	27,907	27,929	27,952	27,975	27,998	28,021	28,044	28,067
Pueblo	19,633	19,640	19,648	19,653	19,658	19,664	19,669	19,674	19,679	19,684	19,688
Weld	33,569	33,592	33,611	33,639	33,659	33,678	33,697	33,717	33,736	33,755	33,773

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:		
	7/5	7/6	7/7	7/8	7/10	7/12	7/14
Adams	61,047	61,063	61,129	61,148	61,203 (12,241) [2,938] {1,469}	61,259 (12,252) [2,940] {1,470}	61,313 (12,263) [2,943] {1,472}
Arapahoe	62,977	62,987	63,033	63,072	63,137 (12,627) [3,031] {1,515}	63,201 (12,640) [3,034] {1,517}	63,262 (12,652) [3,037] {1,518}
Boulder	24,054	24,059	24,087	24,083	24,112 (4,822) [1,157] {579}	24,143 (4,829) [1,159] {579}	24,175 (4,835) [1,160] {580}
Denver	74,504	74,519	74,555	74,583	74,630 (14,926) [3,582] {1,791}	74,676 (14,935) [3,584] {1,792}	74,722 (14,944) [3,587] {1,793}
Douglas	30,602	30,613	30,636	30,652	30,676 (6,135) [1,472] {736}	30,698 (6,140) [1,473] {737}	30,717 (6,143) [1,474] {737}
Eagle	6,369	6,369	6,372	6,374	6,377 (1,275) [306] {153}	6,380 (1,276) [306] {153}	6,384 (1,277) [306] {153}
El Paso	73,673	73,725	73,813	73,908	74,030 (14,806) [3,553] {1,777}	74,151 (14,830) [3,559] {1,780}	74,271 (14,854) [3,565] {1,783}
Gunnison	1,403	1,403	1,404	1,405	1,408 (282) [68] {34}	1,410 (282) [68] {34}	1,413 (283) [68] {34}
Jefferson	49,017	49,023	49,055	49,081	49,121 (9,824) [2,358] {1,179}	49,159 (9,832) [2,360] {1,180}	49,196 (9,839) [2,361] {1,181}
Larimer	27,831	27,845	27,872	27,907	27,952 (5,590) [1,342] {671}	27,998 (5,600) [1,344] {672}	28,044 (5,609) [1,346] {673}
Pueblo	19,633	19,640	19,648	19,653	19,664 (3,933) [944] {472}	19,674 (3,935) [944] {472}	19,684 (3,937) [945] {472}
Weld	33,569	33,592	33,611	33,639	33,678 (6,736) [1,617] {808}	33,717 (6,743) [1,618] {809}	33,755 (6,751) [1,620] {810}

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.