IEM's AI Modeling: Short-term COVID-19 Projections
Date: 6/24/21

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 6/24/21 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
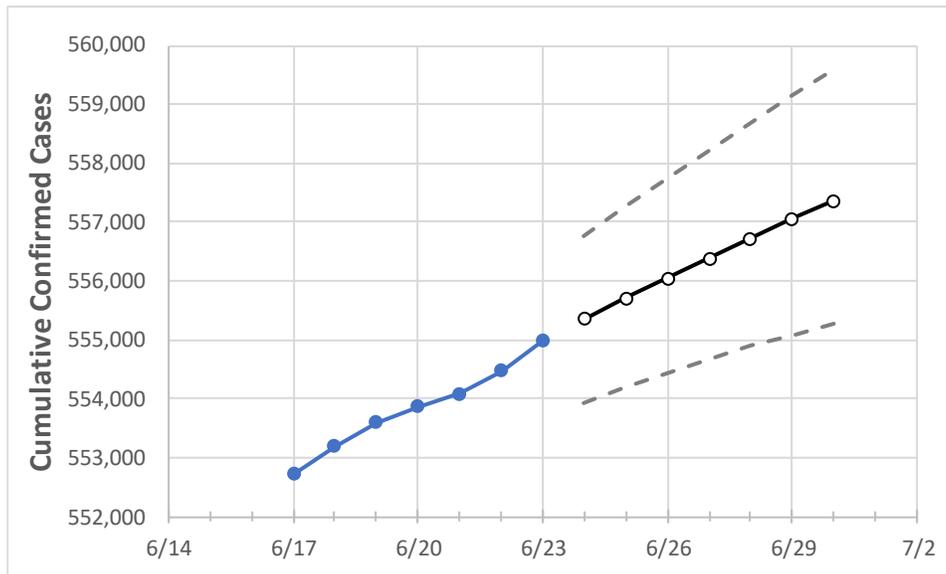
	Actual Confirmed Cases On:				Projected Cases For:						
	6/20	6/21	6/22	6/23	6/24	6/25	6/26	6/27	6/28	6/29	6/30
Colorado	553,868	554,090	554,473	554,977	555,349	555,704	556,039	556,383	556,718	557,050	557,367

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:						
	6/20	6/21	6/22	6/23	6/24	6/25	6/26	6/27	6/28	6/29	6/30
Adams	60,591	60,611	60,655	60,688	60,718	60,748	60,776	60,803	60,830	60,856	60,882
Arapahoe	62,434	62,461	62,497	62,529	62,560	62,591	62,620	62,648	62,675	62,702	62,728
Boulder	23,881	23,885	23,897	23,914	23,922	23,929	23,937	23,944	23,951	23,958	23,964
Denver	74,081	74,091	74,115	74,143	74,174	74,205	74,234	74,263	74,291	74,318	74,345
Douglas	30,244	30,255	30,271	30,383	30,416	30,448	30,479	30,511	30,544	30,576	30,607
Eagle	6,341	6,341	6,344	6,345	6,347	6,349	6,351	6,353	6,355	6,357	6,359
El Paso	72,694	72,736	72,812	72,889	72,957	73,026	73,091	73,153	73,212	73,272	73,326
Gunnison	1,377	1,379	1,381	1,381	1,382	1,384	1,385	1,387	1,388	1,390	1,392
Jefferson	48,666	48,678	48,698	48,711	48,732	48,753	48,774	48,795	48,813	48,833	48,851
Larimer	27,501	27,510	27,537	27,555	27,576	27,596	27,615	27,634	27,653	27,672	27,690
Pueblo	19,495	19,500	19,513	19,521	19,539	19,558	19,576	19,595	19,611	19,629	19,648
Weld	33,223	33,234	33,256	33,290	33,309	33,328	33,346	33,363	33,380	33,397	33,413

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:		
	6/20	6/21	6/22	6/23	6/25	6/27	6/29
Adams	60,591	60,611	60,655	60,688	60,748 (12,150) [2,916] {1,458}	60,803 (12,161) [2,919] {1,459}	60,856 (12,171) [2,921] {1,461}
Arapahoe	62,434	62,461	62,497	62,529	62,591 (12,518) [3,004] {1,502}	62,648 (12,530) [3,007] {1,504}	62,702 (12,540) [3,010] {1,505}
Boulder	23,881	23,885	23,897	23,914	23,929 (4,786) [1,149] {574}	23,944 (4,789) [1,149] {575}	23,958 (4,792) [1,150] {575}
Denver	74,081	74,091	74,115	74,143	74,205 (14,841) [3,562] {1,781}	74,263 (14,853) [3,565] {1,782}	74,318 (14,864) [3,567] {1,784}
Douglas	30,244	30,255	30,271	30,383	30,448 (6,090) [1,462] {731}	30,511 (6,102) [1,465] {732}	30,576 (6,115) [1,468] {734}
Eagle	6,341	6,341	6,344	6,345	6,349 (1,270) [305] {152}	6,353 (1,271) [305] {152}	6,357 (1,271) [305] {153}
El Paso	72,694	72,736	72,812	72,889	73,026 (14,605) [3,505] {1,753}	73,153 (14,631) [3,511] {1,756}	73,272 (14,654) [3,517] {1,759}
Gunnison	1,377	1,379	1,381	1,381	1,384 (277) [66] {33}	1,387 (277) [67] {33}	1,390 (278) [67] {33}
Jefferson	48,666	48,678	48,698	48,711	48,753 (9,751) [2,340] {1,170}	48,795 (9,759) [2,342] {1,171}	48,833 (9,767) [2,344] {1,172}
Larimer	27,501	27,510	27,537	27,555	27,596 (5,519) [1,325] {662}	27,634 (5,527) [1,326] {663}	27,672 (5,534) [1,328] {664}
Pueblo	19,495	19,500	19,513	19,521	19,558 (3,912) [939] {469}	19,595 (3,919) [941] {470}	19,629 (3,926) [942] {471}
Weld	33,223	33,234	33,256	33,290	33,328 (6,666) [1,600] {800}	33,363 (6,673) [1,601] {801}	33,397 (6,679) [1,603] {802}

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.