IEM's AI Modeling: Short-term COVID-19 Projections
Date: 11/12/21

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 <u>not</u> 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 11/12/21 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
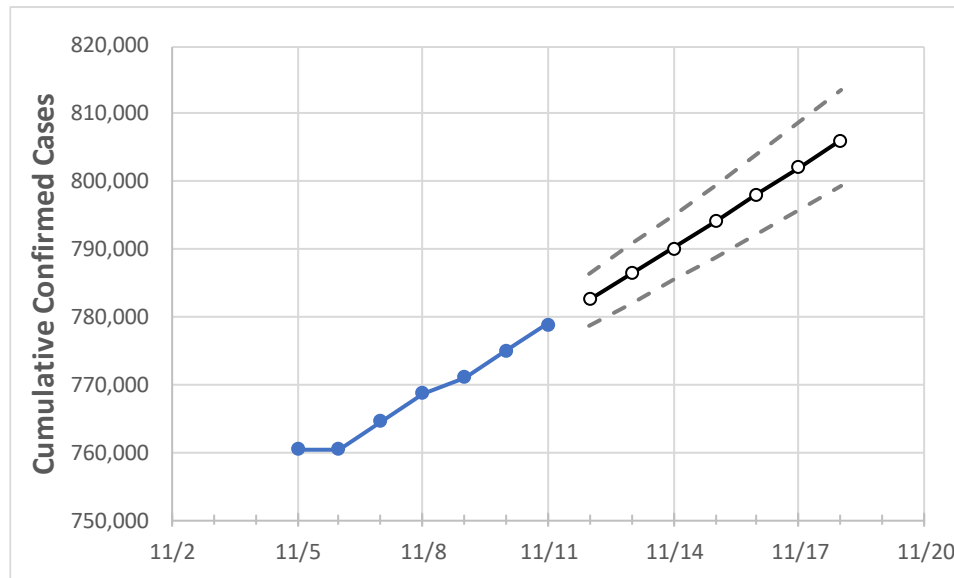
	Actual Confirmed Cases On:				Projected Cases For:						
	11/8	11/9	11/10	11/11	11/12	11/13	11/14	11/15	11/16	11/17	11/18
Colorado	768,646	771,061	774,997	778,909	782,592	786,373	790,144	794,110	798,075	802,085	806,138

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:						
	11/8	11/9	11/10	11/11	11/12	11/13	11/14	11/15	11/16	11/17	11/18
Adams	78,697	78,874	79,187	79,574	79,858	80,147	80,433	80,729	81,031	81,341	81,652
Arapahoe	82,805	83,061	83,385	83,754	84,065	84,380	84,701	85,025	85,364	85,705	86,050
Boulder	32,203	32,325	32,492	32,624	32,766	32,910	33,060	33,207	33,362	33,520	33,677
Denver	95,099	95,406	95,667	96,074	96,412	96,752	97,101	97,451	97,808	98,175	98,543
Douglas	42,249	42,360	42,538	42,741	42,912	43,084	43,254	43,433	43,614	43,795	43,980
Eagle	8,692	8,765	8,808	8,840	8,878	8,916	8,955	8,994	9,035	9,076	9,120
El Paso	106,489	106,790	107,376	107,863	108,309	108,775	109,232	109,698	110,165	110,647	111,126
Gunnison	1,872	1,879	1,883	1,891	1,896	1,900	1,905	1,910	1,915	1,920	1,925
Jefferson	66,630	66,827	67,092	67,533	67,849	68,170	68,503	68,828	69,154	69,502	69,850
Larimer	41,595	41,749	42,016	42,257	42,474	42,689	42,914	43,135	43,359	43,593	43,825
Pueblo	27,084	27,212	27,434	27,607	27,773	27,940	28,111	28,283	28,456	28,635	28,809
Weld	49,095	49,219	49,463	49,701	49,911	50,118	50,326	50,539	50,752	50,967	51,176

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:		
	11/8	11/9	11/10	11/11	11/13	11/15	11/17
Adams	78,697	78,874	79,187	79,574	80,147 (16,029) [3,847] {1,924}	80,729 (16,146) [3,875] {1,937}	81,341 (16,268) [3,904] {1,952}
Arapahoe	82,805	83,061	83,385	83,754	84,380 (16,876) [4,050] {2,025}	85,025 (17,005) [4,081] {2,041}	85,705 (17,141) [4,114] {2,057}
Boulder	32,203	32,325	32,492	32,624	32,910 (6,582) [1,580] {790}	33,207 (6,641) [1,594] {797}	33,520 (6,704) [1,609] {804}
Denver	95,099	95,406	95,667	96,074	96,752 (19,350) [4,644] {2,322}	97,451 (19,490) [4,678] {2,339}	98,175 (19,635) [4,712] {2,356}
Douglas	42,249	42,360	42,538	42,741	43,084 (8,617) [2,068] {1,034}	43,433 (8,687) [2,085] {1,042}	43,795 (8,759) [2,102] {1,051}
Eagle	8,692	8,765	8,808	8,840	8,916 (1,783) [428] {214}	8,994 (1,799) [432] {216}	9,076 (1,815) [436] {218}
El Paso	106,489	106,790	107,376	107,863	108,775 (21,755) [5,221] {2,611}	109,698 (21,940) [5,265] {2,633}	110,647 (22,129) [5,311] {2,656}
Gunnison	1,872	1,879	1,883	1,891	1,900 (380) [91] {46}	1,910 (382) [92] {46}	1,920 (384) [92] {46}
Jefferson	66,630	66,827	67,092	67,533	68,170 (13,634) [3,272] {1,636}	68,828 (13,766) [3,304] {1,652}	69,502 (13,900) [3,336] {1,668}
Larimer	41,595	41,749	42,016	42,257	42,689 (8,538) [2,049] {1,025}	43,135 (8,627) [2,070] {1,035}	43,593 (8,719) [2,092] {1,046}
Pueblo	27,084	27,212	27,434	27,607	27,940 (5,588) [1,341] {671}	28,283 (5,657) [1,358] {679}	28,635 (5,727) [1,374] {687}
Weld	49,095	49,219	49,463	49,701	50,118 (10,024) [2,406] {1,203}	50,539 (10,108) [2,426] {1,213}	50,967 (10,193) [2,446] {1,223}

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.