IEM's AI Modeling: Short-term COVID-19 Projections
Date: 10/11/21

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 10/11/21 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
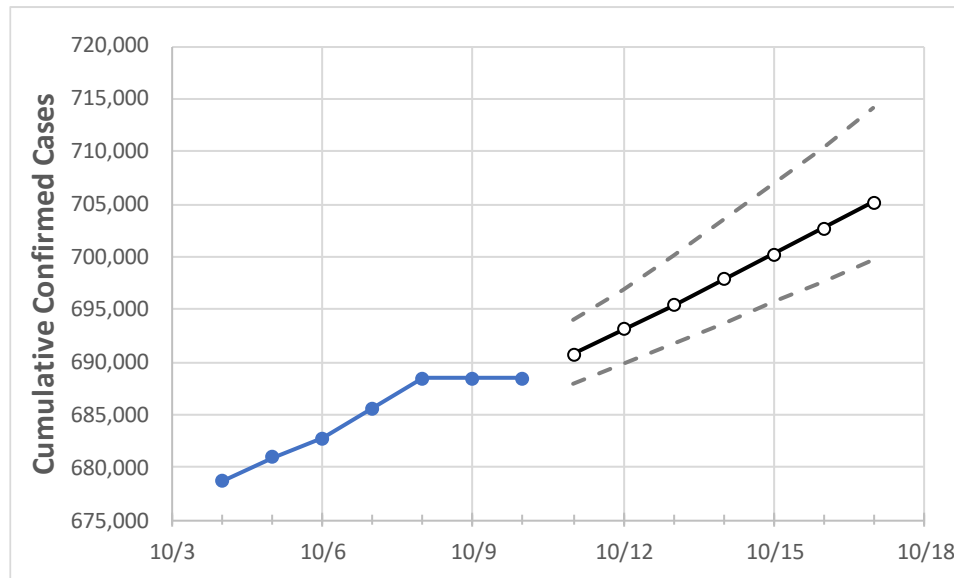
	Actual Confirmed Cases On:				Projected Cases For:						
	10/7	10/8	10/9	10/10	10/11	10/12	10/13	10/14	10/15	10/16	10/17
Colorado	685,554	688,465	688,465	688,465	690,752	693,065	695,429	697,815	700,267	702,703	705,165

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:						
	10/7	10/8	10/9	10/10	10/11	10/12	10/13	10/14	10/15	10/16	10/17
Adams	71,798	71,976	71,976	71,976	72,124	72,274	72,424	72,576	72,728	72,878	73,037
Arapahoe	75,197	75,481	75,481	75,481	75,674	75,868	76,058	76,253	76,451	76,661	76,873
Boulder	29,116	29,246	29,246	29,246	29,333	29,419	29,505	29,596	29,686	29,779	29,871
Denver	87,161	87,441	87,441	87,441	87,658	87,878	88,096	88,321	88,549	88,778	89,015
Douglas	38,040	38,196	38,196	38,196	38,319	38,439	38,562	38,686	38,812	38,939	39,069
Eagle	8,003	8,025	8,025	8,025	8,041	8,057	8,072	8,087	8,103	8,119	8,135
El Paso	94,170	94,658	94,658	94,658	95,040	95,426	95,808	96,199	96,595	96,999	97,399
Gunnison	1,772	1,778	1,778	1,778	1,782	1,786	1,790	1,794	1,798	1,802	1,806
Jefferson	59,301	59,490	59,490	59,490	59,653	59,818	59,982	60,147	60,316	60,485	60,652
Larimer	36,160	36,319	36,319	36,319	36,457	36,594	36,732	36,873	37,015	37,158	37,303
Pueblo	23,115	23,247	23,247	23,247	23,327	23,411	23,492	23,580	23,667	23,754	23,844
Weld	43,014	43,186	43,186	43,186	43,347	43,510	43,676	43,842	44,009	44,180	44,349

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:		
	10/7	10/8	10/9	10/10	10/12	10/14	10/16
Adams	71,798	71,976	71,976	71,976	72,274 (14,455) [3,469] {1,735}	72,576 (14,515) [3,484] {1,742}	72,878 (14,576) [3,498] {1,749}
Arapahoe	75,197	75,481	75,481	75,481	75,868 (15,174) [3,642] {1,821}	76,253 (15,251) [3,660] {1,830}	76,661 (15,332) [3,680] {1,840}
Boulder	29,116	29,246	29,246	29,246	29,419 (5,884) [1,412] {706}	29,596 (5,919) [1,421] {710}	29,779 (5,956) [1,429] {715}
Denver	87,161	87,441	87,441	87,441	87,878 (17,576) [4,218] {2,109}	88,321 (17,664) [4,239] {2,120}	88,778 (17,756) [4,261] {2,131}
Douglas	38,040	38,196	38,196	38,196	38,439 (7,688) [1,845] {923}	38,686 (7,737) [1,857] {928}	38,939 (7,788) [1,869] {935}
Eagle	8,003	8,025	8,025	8,025	8,057 (1,611) [387] {193}	8,087 (1,617) [388] {194}	8,119 (1,624) [390] {195}
El Paso	94,170	94,658	94,658	94,658	95,426 (19,085) [4,580] {2,290}	96,199 (19,240) [4,618] {2,309}	96,999 (19,400) [4,656] {2,328}
Gunnison	1,772	1,778	1,778	1,778	1,786 (357) [86] {43}	1,794 (359) [86] {43}	1,802 (360) [86] {43}
Jefferson	59,301	59,490	59,490	59,490	59,818 (11,964) [2,871] {1,436}	60,147 (12,029) [2,887] {1,444}	60,485 (12,097) [2,903] {1,452}
Larimer	36,160	36,319	36,319	36,319	36,594 (7,319) [1,757] {878}	36,873 (7,375) [1,770] {885}	37,158 (7,432) [1,784] {892}
Pueblo	23,115	23,247	23,247	23,247	23,411 (4,682) [1,124] {562}	23,580 (4,716) [1,132] {566}	23,754 (4,751) [1,140] {570}
Weld	43,014	43,186	43,186	43,186	43,510 (8,702) [2,088] {1,044}	43,842 (8,768) [2,104] {1,052}	44,180 (8,836) [2,121] {1,060}

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.