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

Date: 11/17/21

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 11/17/21 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.

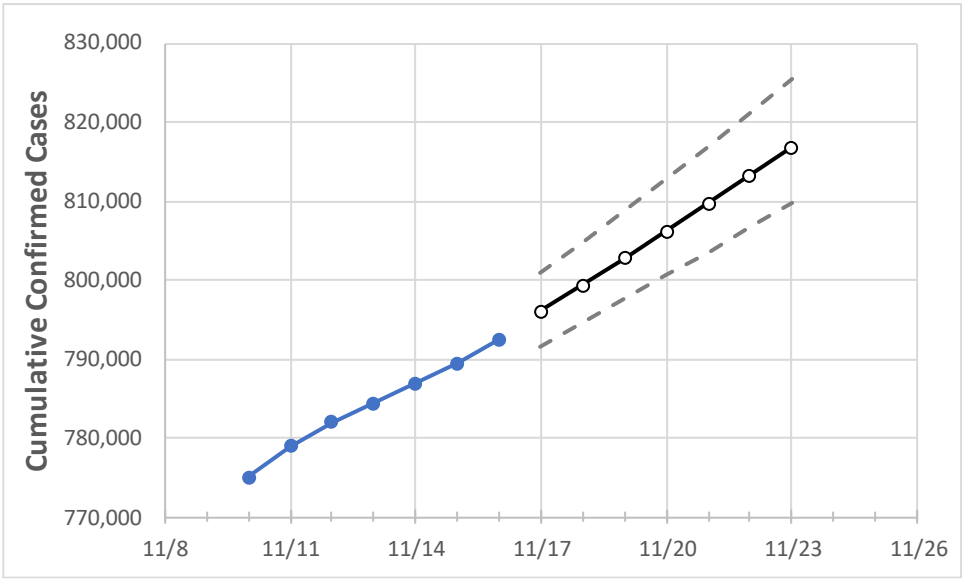
IEM's Modeling Lead

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:						
	11/13	11/14	11/15	11/16	11/17	11/18	11/19	11/20	11/21	11/22	11/23
Colorado	784,450	786,940	789,430	792,498	795,988	799,339	802,709	806,148	809,721	813,240	816,773

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:						
	11/13	11/14	11/15	11/16	11/17	11/18	11/19	11/20	11/21	11/22	11/23
Adams	80,139	80,404	80,669	80,908	81,198	81,484	81,776	82,079	82,373	82,679	82,992
Arapahoe	84,288	84,555	84,823	85,149	85,462	85,769	86,080	86,393	86,719	87,043	87,370
Boulder	32,856	32,952	33,047	33,150	33,277	33,405	33,535	33,664	33,795	33,931	34,066
Denver	96,587	96,826	97,065	97,411	97,717	98,022	98,330	98,640	98,942	99,265	99,581
Douglas	43,029	43,161	43,294	43,463	43,622	43,780	43,940	44,101	44,263	44,426	44,592
Eagle	8,876	8,890	8,903	8,955	8,991	9,026	9,062	9,100	9,139	9,177	9,215
El Paso	108,599	108,930	109,261	109,702	110,116	110,524	110,936	111,346	111,762	112,179	112,595
Gunnison	1,899	1,903	1,907	1,910	1,915	1,920	1,925	1,930	1,935	1,941	1,947
Jefferson	68,075	68,363	68,651	68,989	69,300	69,608	69,923	70,241	70,554	70,880	71,210
Larimer	42,631	42,773	42,915	43,050	43,232	43,413	43,587	43,769	43,948	44,129	44,305
Pueblo	27,854	27,965	28,076	28,175	28,311	28,446	28,580	28,716	28,849	28,990	29,122
Weld	50,034	50,167	50,300	50,507	50,692	50,868	51,048	51,228	51,404	51,582	51,760

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:		
	11/13	11/14	11/15	11/16	11/18	11/20	11/22
Adams	80,139	80,404	80,669	80,908	81,484 (16,297) [3,911] {1,956}	82,079 (16,416) [3,940] {1,970}	82,679 (16,536) [3,969] {1,984}
Arapahoe	84,288	84,555	84,823	85,149	85,769 (17,154) [4,117] {2,058}	86,393 (17,279) [4,147] {2,073}	87,043 (17,409) [4,178] {2,089}
Boulder	32,856	32,952	33,047	33,150	33,405 (6,681) [1,603] {802}	33,664 (6,733) [1,616] {808}	33,931 (6,786) [1,629] {814}
Denver	96,587	96,826	97,065	97,411	98,022 (19,604) [4,705] {2,353}	98,640 (19,728) [4,735] {2,367}	99,265 (19,853) [4,765] {2,382}
Douglas	43,029	43,161	43,294	43,463	43,780 (8,756) [2,101] {1,051}	44,101 (8,820) [2,117] {1,058}	44,426 (8,885) [2,132] {1,066}
Eagle	8,876	8,890	8,903	8,955	9,026 (1,805) [433] {217}	9,100 (1,820) [437] {218}	9,177 (1,835) [441] {220}
El Paso	108,599	108,930	109,261	109,702	110,524 (22,105) [5,305] {2,653}	111,346 (22,269) [5,345] {2,672}	112,179 (22,436) [5,385] {2,692}
Gunnison	1,899	1,903	1,907	1,910	1,920 (384) [92] {46}	1,930 (386) [93] {46}	1,941 (388) [93] {47}
Jefferson	68,075	68,363	68,651	68,989	69,608 (13,922) [3,341] {1,671}	70,241 (14,048) [3,372] {1,686}	70,880 (14,176) [3,402] {1,701}
Larimer	42,631	42,773	42,915	43,050	43,413 (8,683) [2,084] {1,042}	43,769 (8,754) [2,101] {1,050}	44,129 (8,826) [2,118] {1,059}
Pueblo	27,854	27,965	28,076	28,175	28,446 (5,689) [1,365] {683}	28,716 (5,743) [1,378] {689}	28,990 (5,798) [1,391] {696}
Weld	50,034	50,167	50,300	50,507	50,868 (10,174) [2,442] {1,221}	51,228 (10,246) [2,459] {1,229}	51,582 (10,316) [2,476] {1,238}

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.