

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

Date: 12/14/20

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 12/14/20 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.**

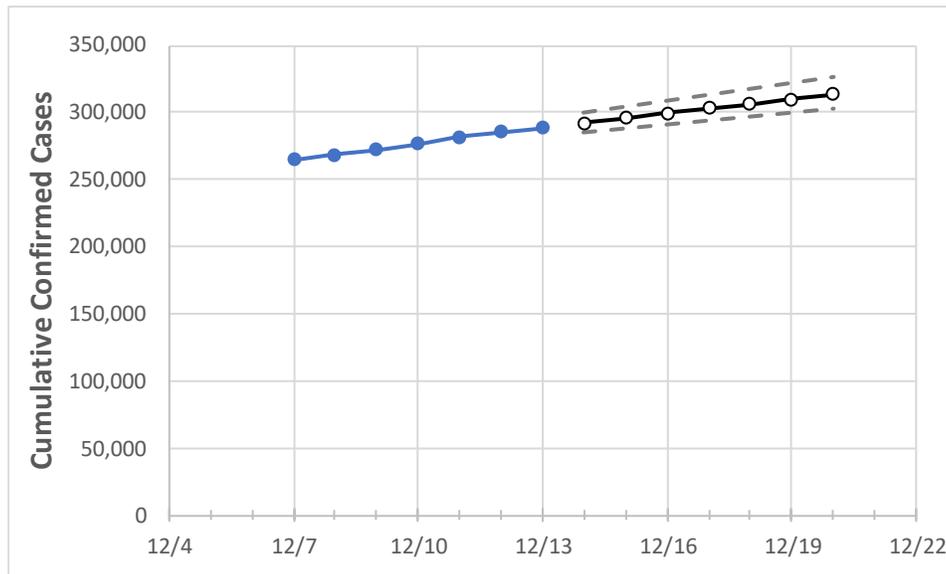
### IEM's Modeling Lead

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:						
	12/10	12/11	12/12	12/13	12/14	12/15	12/16	12/17	12/18	12/19	12/20
Colorado	276,995	281,673	285,634	288,193	291,957	295,675	299,349	302,979	306,566	310,111	313,614

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 20%, and are often within 10%, of actual confirmed cases.

### Colorado Counties

	Actual Confirmed Cases On:				Projected Cases For:						
	12/10	12/11	12/12	12/13	12/14	12/15	12/16	12/17	12/18	12/19	12/20
Adams	34,021	34,484	34,945	35,145	35,510	35,869	36,224	36,573	36,918	37,257	37,592
Arapahoe	31,763	32,306	32,681	32,946	33,336	33,721	34,101	34,476	34,847	35,213	35,574
Boulder	12,576	12,727	12,881	12,948	13,066	13,183	13,297	13,409	13,518	13,626	13,732
Denver	41,309	41,760	42,288	42,578	42,951	43,317	43,677	44,030	44,376	44,716	45,050
Douglas	12,947	13,164	13,353	13,504	13,691	13,876	14,058	14,238	14,416	14,590	14,763
Eagle	2,752	2,782	2,811	2,851	2,889	2,928	2,967	3,007	3,048	3,090	3,133
El Paso	33,618	34,280	34,784	35,123	35,734	36,345	36,956	37,566	38,176	38,785	39,394
Gunnison	518	533	538	542	546	550	555	559	564	569	574
Jefferson	24,779	25,137	25,496	25,748	26,089	26,426	26,760	27,090	27,418	27,742	28,063
Larimer	12,520	12,731	12,942	13,069	13,262	13,455	13,646	13,837	14,026	14,215	14,403
Pueblo	10,946	11,189	11,353	11,415	11,606	11,795	11,982	12,167	12,350	12,531	12,710
Weld	16,611	16,859	17,039	17,240	17,454	17,665	17,873	18,078	18,281	18,480	18,676

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:											
	12/10	12/11	12/12	12/13	12/15			12/17			12/19					
Adams	34,021	34,484	34,945	35,145	35,869	(7,174)	[1,722]	{861}	36,573	(7,315)	[1,756]	{878}	37,257	(7,451)	[1,788]	{894}
Arapahoe	31,763	32,306	32,681	32,946	33,721	(6,744)	[1,619]	{809}	34,476	(6,895)	[1,655]	{827}	35,213	(7,043)	[1,690]	{845}
Boulder	12,576	12,727	12,881	12,948	13,183	(2,637)	[633]	{316}	13,409	(2,682)	[644]	{322}	13,626	(2,725)	[654]	{327}
Denver	41,309	41,760	42,288	42,578	43,317	(8,663)	[2,079]	{1,040}	44,030	(8,806)	[2,113]	{1,057}	44,716	(8,943)	[2,146]	{1,073}
Douglas	12,947	13,164	13,353	13,504	13,876	(2,775)	[666]	{333}	14,238	(2,848)	[683]	{342}	14,590	(2,918)	[700]	{350}
Eagle	2,752	2,782	2,811	2,851	2,928	(586)	[141]	{70}	3,007	(601)	[144]	{72}	3,090	(618)	[148]	{74}
El Paso	33,618	34,280	34,784	35,123	36,345	(7,269)	[1,745]	{872}	37,566	(7,513)	[1,803]	{902}	38,785	(7,757)	[1,862]	{931}
Gunnison	518	533	538	542	550	(110)	[26]	{13}	559	(112)	[27]	{13}	569	(114)	[27]	{14}
Jefferson	24,779	25,137	25,496	25,748	26,426	(5,285)	[1,268]	{634}	27,090	(5,418)	[1,300]	{650}	27,742	(5,548)	[1,332]	{666}
Larimer	12,520	12,731	12,942	13,069	13,455	(2,691)	[646]	{323}	13,837	(2,767)	[664]	{332}	14,215	(2,843)	[682]	{341}
Pueblo	10,946	11,189	11,353	11,415	11,795	(2,359)	[566]	{283}	12,167	(2,433)	[584]	{292}	12,531	(2,506)	[601]	{301}
Weld	16,611	16,859	17,039	17,240	17,665	(3,533)	[848]	{424}	18,078	(3,616)	[868]	{434}	18,480	(3,696)	[887]	{444}

For additional information from IEM, please contact Bryan Koon, Vice President of Emergency Management and Homeland Security at [bryan.koon@iem.com](mailto:bryan.koon@iem.com) or 850-519-7966 or Stephanie Tennyson at [stephanie.tennyson@iem.com](mailto:stephanie.tennyson@iem.com) or 202-309-4257.