

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

Date: 1/14/21

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 1/14/21 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.

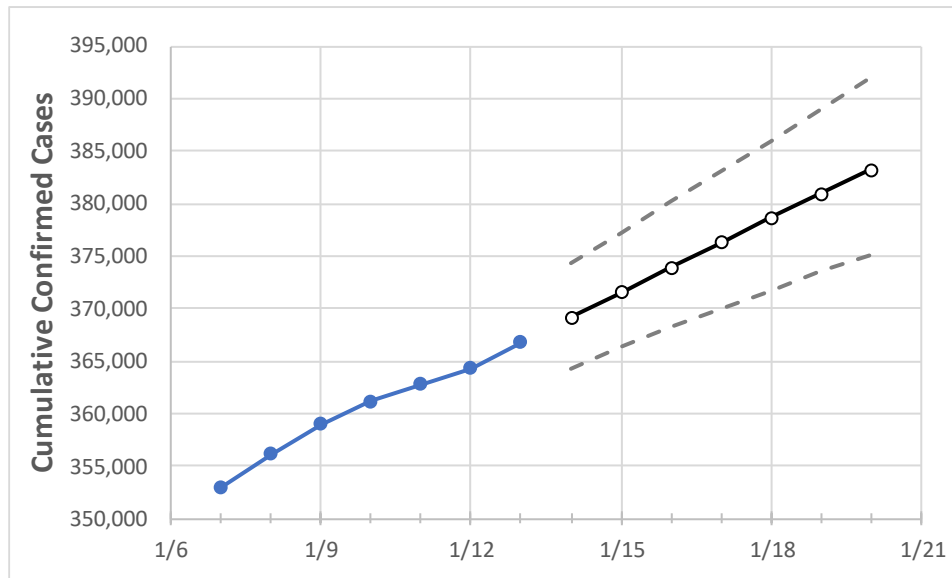
IEM's Modeling Lead

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:							
	1/10	1/11	1/12	1/13	1/14	1/15	1/16	1/17	1/18	1/19	1/20	
Colorado	361,148	362,825	364,336	366,774	369,155	371,547	373,912	376,287	378,606	380,924	383,239	

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:							
	1/10	1/11	1/12	1/13	1/14	1/15	1/16	1/17	1/18	1/19	1/20	
Adams	42,730	42,903	43,028	43,217	43,450	43,678	43,905	44,125	44,344	44,553	44,760	
Arapahoe	41,092	41,314	41,457	41,712	41,992	42,266	42,541	42,823	43,107	43,380	43,648	
Boulder	15,741	15,792	15,847	15,937	16,034	16,130	16,227	16,322	16,417	16,514	16,612	
Denver	51,608	51,825	51,968	52,294	52,653	53,010	53,370	53,739	54,097	54,471	54,833	
Douglas	17,047	17,134	17,218	17,374	17,506	17,637	17,773	17,908	18,047	18,185	18,322	
Eagle	3,692	3,704	3,720	3,752	3,781	3,811	3,842	3,871	3,902	3,931	3,961	
El Paso	44,205	44,372	44,521	44,831	45,086	45,348	45,600	45,852	46,102	46,353	46,600	
Gunnison	787	792	798	813	822	831	840	850	859	869	879	
Jefferson	31,685	31,837	31,950	32,191	32,385	32,576	32,768	32,959	33,149	33,336	33,527	
Larimer	16,204	16,275	16,378	16,482	16,581	16,682	16,781	16,877	16,976	17,072	17,173	
Pueblo	13,802	13,843	13,862	13,894	13,932	13,967	14,002	14,035	14,065	14,096	14,125	
Weld	21,620	21,735	21,841	21,950	22,096	22,242	22,387	22,532	22,679	22,823	22,966	

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:											
	1/10	1/11	1/12	1/13	1/15				1/17				1/19			
Adams	42,730	42,903	43,028	43,217	43,678	(8,736)	[2,097]	{1,048}	44,125	(8,825)	[2,118]	{1,059}	44,553	(8,911)	[2,139]	{1,069}
Arapahoe	41,092	41,314	41,457	41,712	42,266	(8,453)	[2,029]	{1,014}	42,823	(8,565)	[2,056]	{1,028}	43,380	(8,676)	[2,082]	{1,041}
Boulder	15,741	15,792	15,847	15,937	16,130	(3,226)	[774]	{387}	16,322	(3,264)	[783]	{392}	16,514	(3,303)	[793]	{396}
Denver	51,608	51,825	51,968	52,294	53,010	(10,602)	[2,544]	{1,272}	53,739	(10,748)	[2,579]	{1,290}	54,471	(10,894)	[2,615]	{1,307}
Douglas	17,047	17,134	17,218	17,374	17,637	(3,527)	[847]	{423}	17,908	(3,582)	[860]	{430}	18,185	(3,637)	[873]	{436}
Eagle	3,692	3,704	3,720	3,752	3,811	(762)	[183]	{91}	3,871	(774)	[186]	{93}	3,931	(786)	[189]	{94}
El Paso	44,205	44,372	44,521	44,831	45,348	(9,070)	[2,177]	{1,088}	45,852	(9,170)	[2,201]	{1,100}	46,353	(9,271)	[2,225]	{1,112}
Gunnison	787	792	798	813	831	(166)	[40]	{20}	850	(170)	[41]	{20}	869	(174)	[42]	{21}
Jefferson	31,685	31,837	31,950	32,191	32,576	(6,515)	[1,564]	{782}	32,959	(6,592)	[1,582]	{791}	33,336	(6,667)	[1,600]	{800}
Larimer	16,204	16,275	16,378	16,482	16,682	(3,336)	[801]	{400}	16,877	(3,375)	[810]	{405}	17,072	(3,414)	[819]	{410}
Pueblo	13,802	13,843	13,862	13,894	13,967	(2,793)	[670]	{335}	14,035	(2,807)	[674]	{337}	14,096	(2,819)	[677]	{338}
Weld	21,620	21,735	21,841	21,950	22,242	(4,448)	[1,068]	{534}	22,532	(4,506)	[1,082]	{541}	22,823	(4,565)	[1,096]	{548}

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.