

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

Date: 4/14/21

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 4/14/21 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.

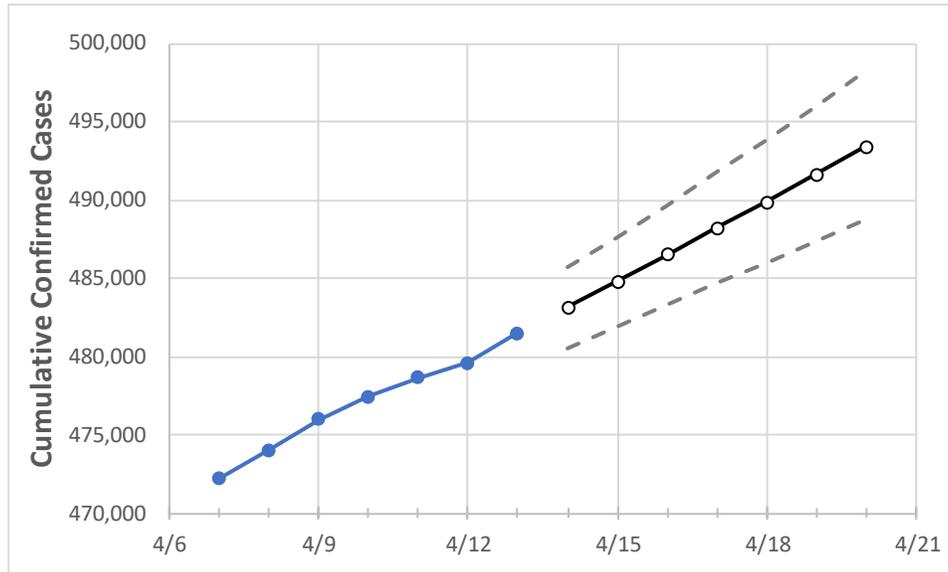
IEM's Modeling Lead

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:						
	4/10	4/11	4/12	4/13	4/14	4/15	4/16	4/17	4/18	4/19	4/20
Colorado	477,443	478,678	479,590	481,494	483,151	484,822	486,490	488,188	489,886	491,649	493,403

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:						
	4/10	4/11	4/12	4/13	4/14	4/15	4/16	4/17	4/18	4/19	4/20
Adams	52,761	52,901	52,997	53,153	53,309	53,468	53,631	53,796	53,966	54,139	54,315
Arapahoe	53,612	53,770	53,861	54,078	54,265	54,457	54,652	54,851	55,054	55,269	55,489
Boulder	21,428	21,477	21,518	21,643	21,731	21,822	21,915	22,007	22,100	22,191	22,286
Denver	66,359	66,509	66,592	66,826	67,034	67,235	67,446	67,657	67,874	68,089	68,304
Douglas	25,016	25,116	25,205	25,355	25,493	25,631	25,773	25,918	26,068	26,219	26,374
Eagle	5,937	5,955	5,961	5,988	6,008	6,027	6,046	6,066	6,086	6,106	6,126
El Paso	58,854	59,003	59,168	59,499	59,745	59,994	60,246	60,505	60,767	61,032	61,297
Gunnison	1,273	1,275	1,276	1,276	1,278	1,280	1,282	1,284	1,286	1,289	1,291
Jefferson	41,807	41,917	41,987	42,136	42,277	42,425	42,572	42,721	42,878	43,037	43,198
Larimer	23,477	23,576	23,647	23,757	23,885	24,018	24,152	24,286	24,422	24,557	24,701
Pueblo	16,338	16,399	16,449	16,540	16,615	16,692	16,772	16,856	16,944	17,036	17,133
Weld	28,405	28,478	28,538	28,656	28,760	28,865	28,975	29,085	29,197	29,311	29,425

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:											
	4/10	4/11	4/12	4/13	4/15				4/17				4/19			
Adams	52,761	52,901	52,997	53,153	53,468	(10,694)	[2,566]	{1,283}	53,796	(10,759)	[2,582]	{1,291}	54,139	(10,828)	[2,599]	{1,299}
Arapahoe	53,612	53,770	53,861	54,078	54,457	(10,891)	[2,614]	{1,307}	54,851	(10,970)	[2,633]	{1,316}	55,269	(11,054)	[2,653]	{1,326}
Boulder	21,428	21,477	21,518	21,643	21,822	(4,364)	[1,047]	{524}	22,007	(4,401)	[1,056]	{528}	22,191	(4,438)	[1,065]	{533}
Denver	66,359	66,509	66,592	66,826	67,235	(13,447)	[3,227]	{1,614}	67,657	(13,531)	[3,248]	{1,624}	68,089	(13,618)	[3,268]	{1,634}
Douglas	25,016	25,116	25,205	25,355	25,631	(5,126)	[1,230]	{615}	25,918	(5,184)	[1,244]	{622}	26,219	(5,244)	[1,258]	{629}
Eagle	5,937	5,955	5,961	5,988	6,027	(1,205)	[289]	{145}	6,066	(1,213)	[291]	{146}	6,106	(1,221)	[293]	{147}
El Paso	58,854	59,003	59,168	59,499	59,994	(11,999)	[2,880]	{1,440}	60,505	(12,101)	[2,904]	{1,452}	61,032	(12,206)	[2,930]	{1,465}
Gunnison	1,273	1,275	1,276	1,276	1,280	(256)	[61]	{31}	1,284	(257)	[62]	{31}	1,289	(258)	[62]	{31}
Jefferson	41,807	41,917	41,987	42,136	42,425	(8,485)	[2,036]	{1,018}	42,721	(8,544)	[2,051]	{1,025}	43,037	(8,607)	[2,066]	{1,033}
Larimer	23,477	23,576	23,647	23,757	24,018	(4,804)	[1,153]	{576}	24,286	(4,857)	[1,166]	{583}	24,557	(4,911)	[1,179]	{589}
Pueblo	16,338	16,399	16,449	16,540	16,692	(3,338)	[801]	{401}	16,856	(3,371)	[809]	{405}	17,036	(3,407)	[818]	{409}
Weld	28,405	28,478	28,538	28,656	28,865	(5,773)	[1,386]	{693}	29,085	(5,817)	[1,396]	{698}	29,311	(5,862)	[1,407]	{703}

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.