

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

Date: 6/25/20

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

The projections shown in this document are based on data pulled in as of 6/25/20 11 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.

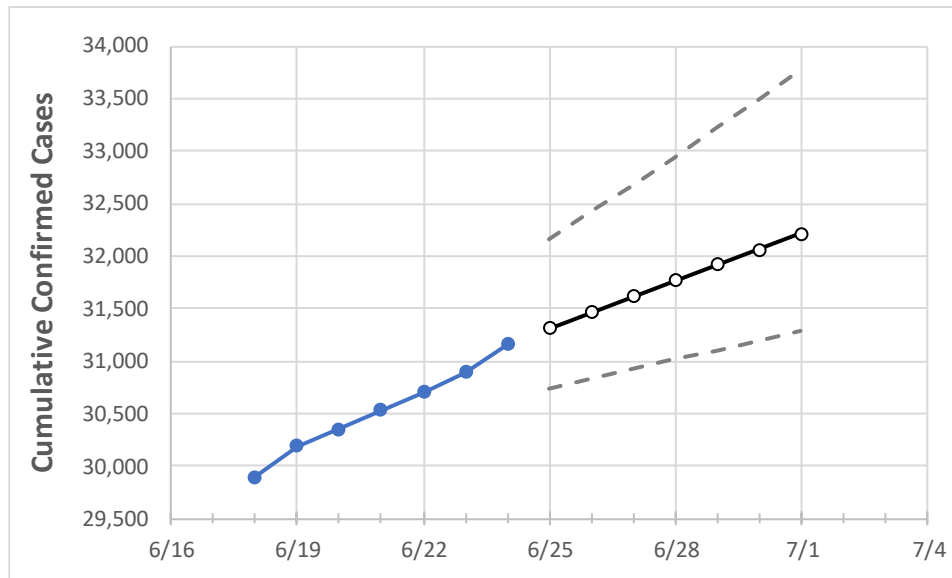
IEM's Modeling Lead

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:						
	6/21	6/22	6/23	6/24	6/25	6/26	6/27	6/28	6/29	6/30	7/1
Colorado	30,536	30,704	30,892	31,155	31,309	31,462	31,614	31,765	31,915	32,065	32,213

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:						
	6/21	6/22	6/23	6/24	6/25	6/26	6/27	6/28	6/29	6/30	7/1
Adams	3,909	3,932	3,941	3,971	3,988	4,004	4,019	4,035	4,050	4,065	4,079
Arapahoe	4,941	4,975	4,993	5,022	5,038	5,054	5,070	5,086	5,101	5,116	5,130
Boulder	1,243	1,259	1,282	1,305	1,330	1,357	1,387	1,418	1,453	1,490	1,530
Denver	6,630	6,663	6,700	6,775	6,809	6,843	6,877	6,910	6,944	6,977	7,011
Douglas	852	864	869	873	880	887	894	902	909	917	925
Eagle	649	656	660	665	669	673	677	681	686	691	696
El Paso	2,101	2,113	2,139	2,173	2,192	2,211	2,230	2,250	2,270	2,291	2,312
Gunnison	183	184	184	186	186	187	187	187	188	188	188
Jefferson	2,532	2,543	2,555	2,569	2,576	2,583	2,589	2,596	2,602	2,608	2,614
Larimer	680	682	683	686	689	691	693	696	698	701	703
Pueblo	357	358	363	368	369	370	372	373	374	375	376
Weld	2,721	2,724	2,730	2,746	2,752	2,758	2,764	2,770	2,776	2,781	2,787

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:											
	6/21	6/22	6/23	6/24	6/26				6/28				6/30			
Adams	3,909	3,932	3,941	3,971	4,004	(801)	[192]	{96}	4,035	(807)	[194]	{97}	4,065	(813)	[195]	{98}
Arapahoe	4,941	4,975	4,993	5,022	5,054	(1,011)	[243]	{121}	5,086	(1,017)	[244]	{122}	5,116	(1,023)	[246]	{123}
Boulder	1,243	1,259	1,282	1,305	1,357	(271)	[65]	{33}	1,418	(284)	[68]	{34}	1,490	(298)	[72]	{36}
Denver	6,630	6,663	6,700	6,775	6,843	(1,369)	[328]	{164}	6,910	(1,382)	[332]	{166}	6,977	(1,395)	[335]	{167}
Douglas	852	864	869	873	887	(177)	[43]	{21}	902	(180)	[43]	{22}	917	(183)	[44]	{22}
Eagle	649	656	660	665	673	(135)	[32]	{16}	681	(136)	[33]	{16}	691	(138)	[33]	{17}
El Paso	2,101	2,113	2,139	2,173	2,211	(442)	[106]	{53}	2,250	(450)	[108]	{54}	2,291	(458)	[110]	{55}
Gunnison	183	184	184	186	187	(37)	[9]	{4}	187	(37)	[9]	{4}	188	(38)	[9]	{5}
Jefferson	2,532	2,543	2,555	2,569	2,583	(517)	[124]	{62}	2,596	(519)	[125]	{62}	2,608	(522)	[125]	{63}
Larimer	680	682	683	686	691	(138)	[33]	{17}	696	(139)	[33]	{17}	701	(140)	[34]	{17}
Pueblo	357	358	363	368	370	(74)	[18]	{9}	373	(75)	[18]	{9}	375	(75)	[18]	{9}
Weld	2,721	2,724	2,730	2,746	2,758	(552)	[132]	{66}	2,770	(554)	[133]	{66}	2,781	(556)	[133]	{67}

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.