

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

Date: 12/8/20

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 12/8/20 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.

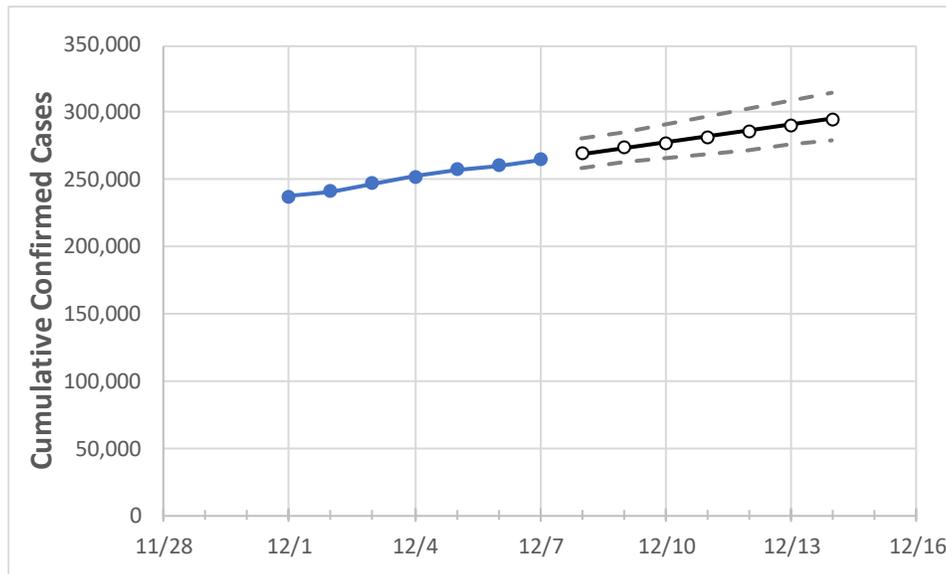
IEM's Modeling Lead

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:						
	12/4	12/5	12/6	12/7	12/8	12/9	12/10	12/11	12/12	12/13	12/14
Colorado	252,222	257,347	260,581	264,618	269,008	273,391	277,767	282,136	286,499	290,854	295,202

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:						
	12/4	12/5	12/6	12/7	12/8	12/9	12/10	12/11	12/12	12/13	12/14
Adams	31,535	32,044	32,334	32,758	33,173	33,585	33,994	34,400	34,803	35,203	35,600
Arapahoe	29,191	29,769	30,170	30,569	31,005	31,440	31,873	32,304	32,733	33,160	33,585
Boulder	11,775	11,949	12,043	12,163	12,298	12,430	12,561	12,689	12,816	12,941	13,065
Denver	38,770	39,327	39,770	40,176	40,628	41,073	41,513	41,947	42,375	42,797	43,214
Douglas	11,714	11,970	12,167	12,349	12,567	12,784	13,001	13,218	13,435	13,651	13,868
Eagle	2,498	2,536	2,572	2,601	2,634	2,668	2,703	2,738	2,773	2,809	2,845
El Paso	30,174	30,761	31,181	31,738	32,373	33,012	33,656	34,303	34,954	35,609	36,267
Gunnison	493	495	502	508	511	515	519	522	526	530	534
Jefferson	22,352	22,830	23,132	23,842	24,255	24,670	25,087	25,507	25,930	26,354	26,781
Larimer	11,164	11,519	11,664	11,825	12,034	12,243	12,451	12,660	12,868	13,076	13,284
Pueblo	9,540	9,749	9,884	10,126	10,348	10,570	10,792	11,014	11,235	11,456	11,677
Weld	15,145	15,486	15,679	15,877	16,127	16,375	16,623	16,869	17,113	17,357	17,599

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:											
	12/4	12/5	12/6	12/7	12/9			12/11			12/13					
Adams	31,535	32,044	32,334	32,758	33,585	(6,717)	[1,612]	{806}	34,400	(6,880)	[1,651]	{826}	35,203	(7,041)	[1,690]	{845}
Arapahoe	29,191	29,769	30,170	30,569	31,440	(6,288)	[1,509]	{755}	32,304	(6,461)	[1,551]	{775}	33,160	(6,632)	[1,592]	{796}
Boulder	11,775	11,949	12,043	12,163	12,430	(2,486)	[597]	{298}	12,689	(2,538)	[609]	{305}	12,941	(2,588)	[621]	{311}
Denver	38,770	39,327	39,770	40,176	41,073	(8,215)	[1,972]	{986}	41,947	(8,389)	[2,013]	{1,007}	42,797	(8,559)	[2,054]	{1,027}
Douglas	11,714	11,970	12,167	12,349	12,784	(2,557)	[614]	{307}	13,218	(2,644)	[634]	{317}	13,651	(2,730)	[655]	{328}
Eagle	2,498	2,536	2,572	2,601	2,668	(534)	[128]	{64}	2,738	(548)	[131]	{66}	2,809	(562)	[135]	{67}
El Paso	30,174	30,761	31,181	31,738	33,012	(6,602)	[1,585]	{792}	34,303	(6,861)	[1,647]	{823}	35,609	(7,122)	[1,709]	{855}
Gunnison	493	495	502	508	515	(103)	[25]	{12}	522	(104)	[25]	{13}	530	(106)	[25]	{13}
Jefferson	22,352	22,830	23,132	23,842	24,670	(4,934)	[1,184]	{592}	25,507	(5,101)	[1,224]	{612}	26,354	(5,271)	[1,265]	{632}
Larimer	11,164	11,519	11,664	11,825	12,243	(2,449)	[588]	{294}	12,660	(2,532)	[608]	{304}	13,076	(2,615)	[628]	{314}
Pueblo	9,540	9,749	9,884	10,126	10,570	(2,114)	[507]	{254}	11,014	(2,203)	[529]	{264}	11,456	(2,291)	[550]	{275}
Weld	15,145	15,486	15,679	15,877	16,375	(3,275)	[786]	{393}	16,869	(3,374)	[810]	{405}	17,357	(3,471)	[833]	{417}

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.