

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

Date: 12/28/20

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 12/28/20 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.

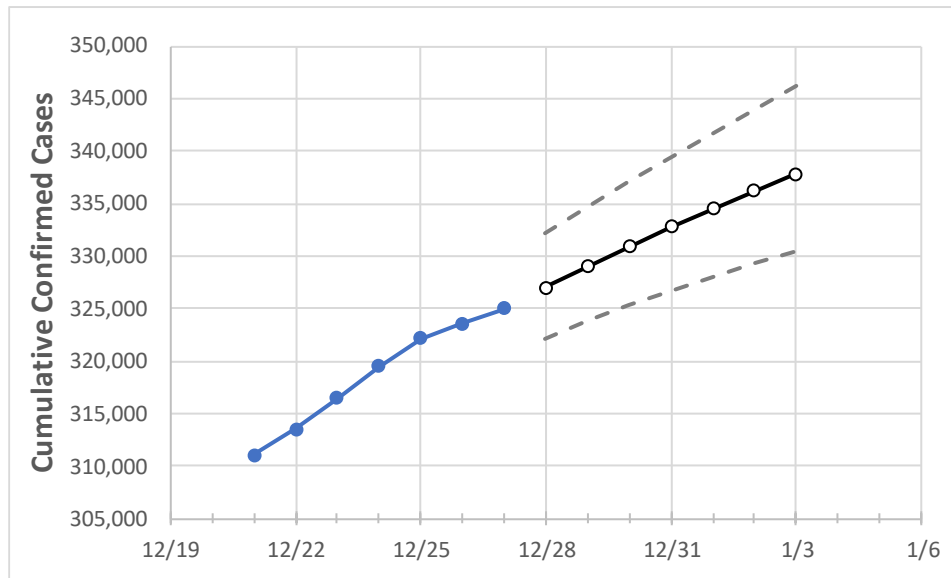
IEM's Modeling Lead

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:						
	12/24	12/25	12/26	12/27	12/28	12/29	12/30	12/31	1/1	1/2	1/3
Colorado	319,530	322,189	323,619	325,018	327,015	328,969	330,910	332,752	334,505	336,202	337,840

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:						
	12/24	12/25	12/26	12/27	12/28	12/29	12/30	12/31	1/1	1/2	1/3
Adams	38,210	38,525	38,691	38,849	39,053	39,253	39,447	39,632	39,814	39,986	40,155
Arapahoe	36,328	36,692	36,844	36,976	37,204	37,432	37,646	37,856	38,054	38,251	38,443
Boulder	14,022	14,125	14,222	14,276	14,354	14,429	14,502	14,573	14,642	14,710	14,775
Denver	45,920	46,258	46,455	46,570	46,802	47,025	47,239	47,454	47,660	47,863	48,065
Douglas	14,945	15,039	15,116	15,168	15,259	15,346	15,432	15,514	15,593	15,669	15,743
Eagle	3,167	3,190	3,200	3,226	3,248	3,270	3,291	3,312	3,332	3,352	3,370
El Paso	39,373	39,656	39,805	39,887	40,135	40,374	40,605	40,827	41,047	41,261	41,460
Gunnison	659	665	667	670	680	690	700	711	722	734	745
Jefferson	28,357	28,559	28,695	28,828	28,996	29,161	29,318	29,471	29,615	29,756	29,894
Larimer	14,468	14,570	14,619	14,676	14,760	14,842	14,920	14,995	15,067	15,135	15,198
Pueblo	12,744	12,827	12,854	12,884	12,954	13,022	13,086	13,147	13,205	13,257	13,309
Weld	18,985	19,157	19,228	19,361	19,478	19,594	19,709	19,819	19,926	20,029	20,130

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:							
	12/24	12/25	12/26	12/27	12/29		12/31		1/2			
Adams	38,210	38,525	38,691	38,849	39,253	(7,851) [1,884] {942}	39,632	(7,926) [1,902] {951}	39,986	(7,997) [1,919] {960}		
Arapahoe	36,328	36,692	36,844	36,976	37,432	(7,486) [1,797] {898}	37,856	(7,571) [1,817] {909}	38,251	(7,650) [1,836] {918}		
Boulder	14,022	14,125	14,222	14,276	14,429	(2,886) [693] {346}	14,573	(2,915) [700] {350}	14,710	(2,942) [706] {353}		
Denver	45,920	46,258	46,455	46,570	47,025	(9,405) [2,257] {1,129}	47,454	(9,491) [2,278] {1,139}	47,863	(9,573) [2,297] {1,149}		
Douglas	14,945	15,039	15,116	15,168	15,346	(3,069) [737] {368}	15,514	(3,103) [745] {372}	15,669	(3,134) [752] {376}		
Eagle	3,167	3,190	3,200	3,226	3,270	(654) [157] {78}	3,312	(662) [159] {79}	3,352	(670) [161] {80}		
El Paso	39,373	39,656	39,805	39,887	40,374	(8,075) [1,938] {969}	40,827	(8,165) [1,960] {980}	41,261	(8,252) [1,981] {990}		
Gunnison	659	665	667	670	690	(138) [33] {17}	711	(142) [34] {17}	734	(147) [35] {18}		
Jefferson	28,357	28,559	28,695	28,828	29,161	(5,832) [1,400] {700}	29,471	(5,894) [1,415] {707}	29,756	(5,951) [1,428] {714}		
Larimer	14,468	14,570	14,619	14,676	14,842	(2,968) [712] {356}	14,995	(2,999) [720] {360}	15,135	(3,027) [726] {363}		
Pueblo	12,744	12,827	12,854	12,884	13,022	(2,604) [625] {313}	13,147	(2,629) [631] {316}	13,257	(2,651) [636] {318}		
Weld	18,985	19,157	19,228	19,361	19,594	(3,919) [941] {470}	19,819	(3,964) [951] {476}	20,029	(4,006) [961] {481}		

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.