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

Date: 12/15/20

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 12/15/20 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.

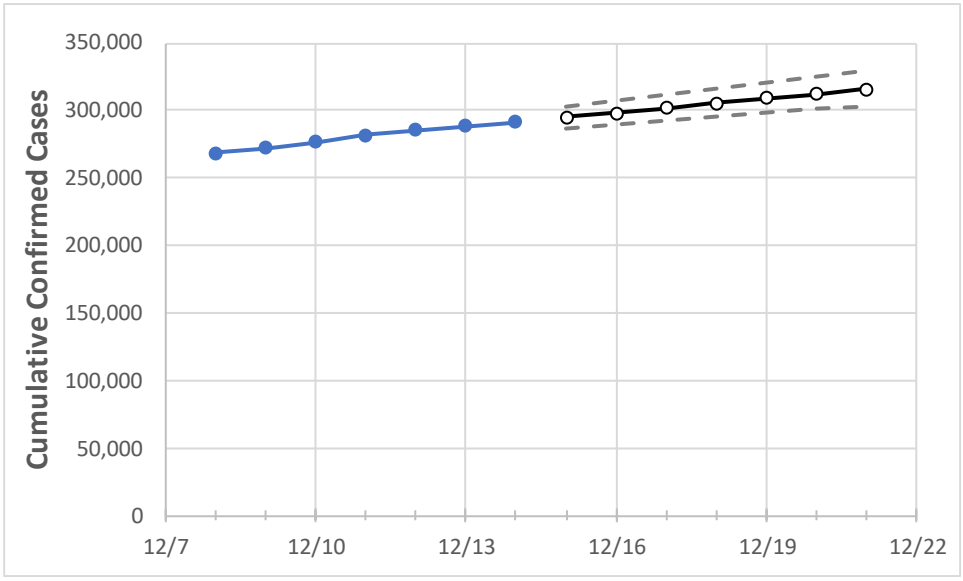
IEM's Modeling Lead

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:						
	12/11	12/12	12/13	12/14	12/15	12/16	12/17	12/18	12/19	12/20	12/21
Colorado	281,673	285,634	288,193	291,104	294,791	298,422	301,999	305,521	308,991	312,407	315,771

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:						
	12/11	12/12	12/13	12/14	12/15	12/16	12/17	12/18	12/19	12/20	12/21
Adams	34,484	34,945	35,145	35,483	35,856	36,224	36,587	36,946	37,299	37,648	37,992
Arapahoe	32,306	32,681	32,946	33,292	33,683	34,070	34,452	34,831	35,204	35,574	35,939
Boulder	12,727	12,881	12,948	13,057	13,181	13,304	13,424	13,543	13,659	13,774	13,887
Denver	41,760	42,288	42,578	42,850	43,220	43,583	43,938	44,286	44,627	44,961	45,288
Douglas	13,164	13,353	13,504	13,620	13,791	13,959	14,123	14,284	14,441	14,594	14,745
Eagle	2,782	2,811	2,851	2,904	2,946	2,989	3,032	3,076	3,121	3,167	3,214
El Paso	34,280	34,784	35,123	35,496	36,048	36,595	37,137	37,673	38,203	38,729	39,249
Gunnison	533	538	542	545	551	556	562	568	574	580	586
Jefferson	25,137	25,496	25,748	25,931	26,256	26,575	26,889	27,198	27,501	27,800	28,094
Larimer	12,731	12,942	13,069	13,158	13,349	13,538	13,725	13,910	14,094	14,276	14,456
Pueblo	11,189	11,353	11,415	11,615	11,818	12,019	12,218	12,416	12,612	12,807	13,000
Weld	16,859	17,039	17,240	17,432	17,645	17,854	18,060	18,262	18,462	18,658	18,851

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:		
	12/11	12/12	12/13	12/14	12/16	12/18	12/20
Adams	34,484	34,945	35,145	35,483	36,224 (7,245) [1,739] {869}	36,946 (7,389) [1,773] {887}	37,648 (7,530) [1,807] {904}
Arapahoe	32,306	32,681	32,946	33,292	34,070 (6,814) [1,635] {818}	34,831 (6,966) [1,672] {836}	35,574 (7,115) [1,708] {854}
Boulder	12,727	12,881	12,948	13,057	13,304 (2,661) [639] {319}	13,543 (2,709) [650] {325}	13,774 (2,755) [661] {331}
Denver	41,760	42,288	42,578	42,850	43,583 (8,717) [2,092] {1,046}	44,286 (8,857) [2,126] {1,063}	44,961 (8,992) [2,158] {1,079}
Douglas	13,164	13,353	13,504	13,620	13,959 (2,792) [670] {335}	14,284 (2,857) [686] {343}	14,594 (2,919) [701] {350}
Eagle	2,782	2,811	2,851	2,904	2,989 (598) [143] {72}	3,076 (615) [148] {74}	3,167 (633) [152] {76}
El Paso	34,280	34,784	35,123	35,496	36,595 (7,319) [1,757] {878}	37,673 (7,535) [1,808] {904}	38,729 (7,746) [1,859] {929}
Gunnison	533	538	542	545	556 (111) [27] {13}	568 (114) [27] {14}	580 (116) [28] {14}
Jefferson	25,137	25,496	25,748	25,931	26,575 (5,315) [1,276] {638}	27,198 (5,440) [1,305] {653}	27,800 (5,560) [1,334] {667}
Larimer	12,731	12,942	13,069	13,158	13,538 (2,708) [650] {325}	13,910 (2,782) [668] {334}	14,276 (2,855) [685] {343}
Pueblo	11,189	11,353	11,415	11,615	12,019 (2,404) [577] {288}	12,416 (2,483) [596] {298}	12,807 (2,561) [615] {307}
Weld	16,859	17,039	17,240	17,432	17,854 (3,571) [857] {428}	18,262 (3,652) [877] {438}	18,658 (3,732) [896] {448}

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.