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

Date: 12/16/20

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 12/16/20 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.

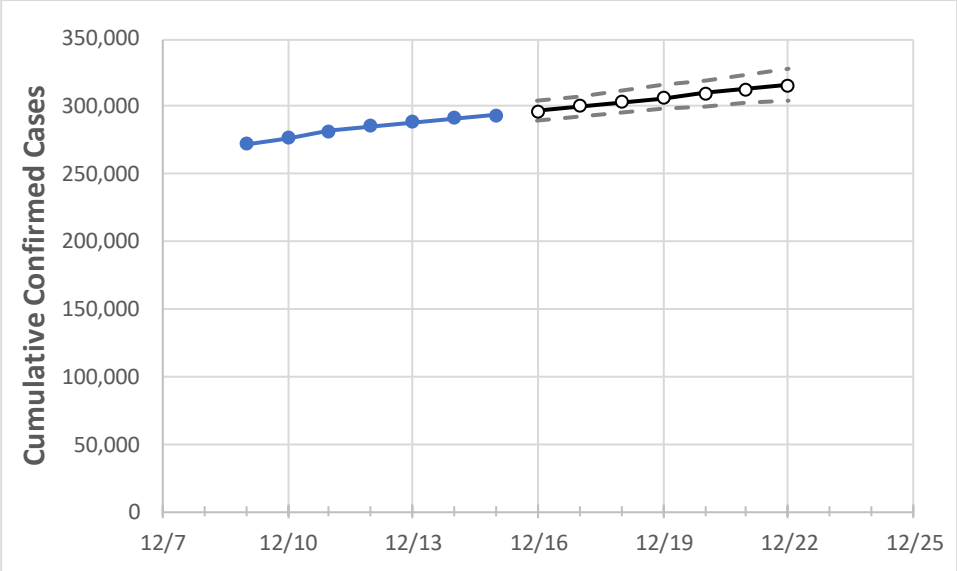
IEM's Modeling Lead

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:						
	12/12	12/13	12/14	12/15	12/16	12/17	12/18	12/19	12/20	12/21	12/22
Colorado	285,634	288,193	291,104	293,382	296,772	300,085	303,324	306,490	309,586	312,613	315,571

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:						
	12/12	12/13	12/14	12/15	12/16	12/17	12/18	12/19	12/20	12/21	12/22
Adams	34,945	35,145	35,483	35,725	36,071	36,411	36,747	37,076	37,401	37,720	38,035
Arapahoe	32,681	32,946	33,292	33,538	33,903	34,263	34,617	34,966	35,309	35,648	35,981
Boulder	12,881	12,948	13,057	13,139	13,251	13,361	13,469	13,574	13,677	13,778	13,877
Denver	42,288	42,578	42,850	43,034	43,368	43,694	44,012	44,321	44,623	44,917	45,203
Douglas	13,353	13,504	13,620	13,752	13,914	14,073	14,228	14,380	14,528	14,673	14,814
Eagle	2,811	2,851	2,904	2,938	2,979	3,021	3,063	3,106	3,150	3,193	3,238
El Paso	34,784	35,123	35,496	35,784	36,296	36,801	37,297	37,786	38,266	38,740	39,206
Gunnison	538	542	545	554	560	565	571	577	583	589	596
Jefferson	25,496	25,748	25,931	26,117	26,416	26,709	26,996	27,277	27,552	27,822	28,086
Larimer	12,942	13,069	13,158	13,273	13,452	13,629	13,803	13,974	14,143	14,310	14,474
Pueblo	11,353	11,415	11,615	11,705	11,887	12,065	12,241	12,415	12,585	12,753	12,919
Weld	17,039	17,240	17,432	17,566	17,762	17,955	18,144	18,329	18,510	18,688	18,862

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:		
	12/12	12/13	12/14	12/15	12/17	12/19	12/21
Adams	34,945	35,145	35,483	35,725	36,411 (7,282) [1,748] {874}	37,076 (7,415) [1,780] {890}	37,720 (7,544) [1,811] {905}
Arapahoe	32,681	32,946	33,292	33,538	34,263 (6,853) [1,645] {822}	34,966 (6,993) [1,678] {839}	35,648 (7,130) [1,711] {856}
Boulder	12,881	12,948	13,057	13,139	13,361 (2,672) [641] {321}	13,574 (2,715) [652] {326}	13,778 (2,756) [661] {331}
Denver	42,288	42,578	42,850	43,034	43,694 (8,739) [2,097] {1,049}	44,321 (8,864) [2,127] {1,064}	44,917 (8,983) [2,156] {1,078}
Douglas	13,353	13,504	13,620	13,752	14,073 (2,815) [676] {338}	14,380 (2,876) [690] {345}	14,673 (2,935) [704] {352}
Eagle	2,811	2,851	2,904	2,938	3,021 (604) [145] {73}	3,106 (621) [149] {75}	3,193 (639) [153] {77}
El Paso	34,784	35,123	35,496	35,784	36,801 (7,360) [1,766] {883}	37,786 (7,557) [1,814] {907}	38,740 (7,748) [1,860] {930}
Gunnison	538	542	545	554	565 (113) [27] {14}	577 (115) [28] {14}	589 (118) [28] {14}
Jefferson	25,496	25,748	25,931	26,117	26,709 (5,342) [1,282] {641}	27,277 (5,455) [1,309] {655}	27,822 (5,564) [1,335] {668}
Larimer	12,942	13,069	13,158	13,273	13,629 (2,726) [654] {327}	13,974 (2,795) [671] {335}	14,310 (2,862) [687] {343}
Pueblo	11,353	11,415	11,615	11,705	12,065 (2,413) [579] {290}	12,415 (2,483) [596] {298}	12,753 (2,551) [612] {306}
Weld	17,039	17,240	17,432	17,566	17,955 (3,591) [862] {431}	18,329 (3,666) [880] {440}	18,688 (3,738) [897] {449}

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.