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

Date: 11/30/20

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 11/30/20 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.

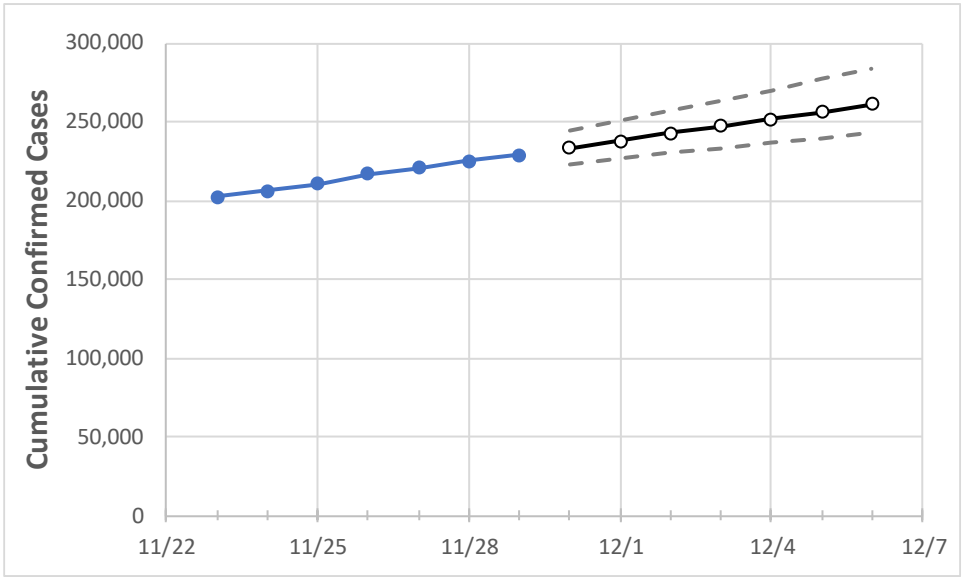
IEM's Modeling Lead

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:						
	11/26	11/27	11/28	11/29	11/30	12/1	12/2	12/3	12/4	12/5	12/6
Colorado	216,683	220,953	225,283	228,772	233,375	237,983	242,596	247,213	251,834	256,459	261,088

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:						
	11/26	11/27	11/28	11/29	11/30	12/1	12/2	12/3	12/4	12/5	12/6
Adams	27,838	28,347	28,784	29,130	29,568	30,001	30,429	30,853	31,272	31,687	32,097
Arapahoe	25,535	25,936	26,391	26,753	27,189	27,621	28,049	28,473	28,893	29,309	29,720
Boulder	10,495	10,669	10,793	10,926	11,077	11,226	11,374	11,519	11,663	11,805	11,945
Denver	35,075	35,490	35,906	36,243	36,786	37,325	37,859	38,389	38,915	39,436	39,953
Douglas	9,967	10,183	10,404	10,560	10,793	11,026	11,259	11,490	11,722	11,952	12,183
Eagle	2,237	2,272	2,338	2,364	2,399	2,434	2,471	2,508	2,546	2,585	2,625
El Paso	24,712	25,425	26,026	26,639	27,280	27,929	28,586	29,250	29,922	30,602	31,290
Gunnison	451	461	466	471	474	476	479	482	484	487	490
Jefferson	19,348	19,704	20,106	20,358	20,748	21,136	21,524	21,910	22,296	22,681	23,065
Larimer	9,545	9,726	9,946	10,115	10,330	10,543	10,757	10,969	11,181	11,393	11,604
Pueblo	7,602	7,860	8,077	8,269	8,516	8,766	9,017	9,270	9,524	9,781	10,039
Weld	13,111	13,353	13,620	13,813	14,092	14,370	14,649	14,927	15,206	15,484	15,763

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:		
	11/26	11/27	11/28	11/29	12/1	12/3	12/5
Adams	27,838	28,347	28,784	29,130	30,001 (6,000) [1,440] {720}	30,853 (6,171) [1,481] {740}	31,687 (6,337) [1,521] {760}
Arapahoe	25,535	25,936	26,391	26,753	27,621 (5,524) [1,326] {663}	28,473 (5,695) [1,367] {683}	29,309 (5,862) [1,407] {703}
Boulder	10,495	10,669	10,793	10,926	11,226 (2,245) [539] {269}	11,519 (2,304) [553] {276}	11,805 (2,361) [567] {283}
Denver	35,075	35,490	35,906	36,243	37,325 (7,465) [1,792] {896}	38,389 (7,678) [1,843] {921}	39,436 (7,887) [1,893] {946}
Douglas	9,967	10,183	10,404	10,560	11,026 (2,205) [529] {265}	11,490 (2,298) [552] {276}	11,952 (2,390) [574] {287}
Eagle	2,237	2,272	2,338	2,364	2,434 (487) [117] {58}	2,508 (502) [120] {60}	2,585 (517) [124] {62}
El Paso	24,712	25,425	26,026	26,639	27,929 (5,586) [1,341] {670}	29,250 (5,850) [1,404] {702}	30,602 (6,120) [1,469] {734}
Gunnison	451	461	466	471	476 (95) [23] {11}	482 (96) [23] {12}	487 (97) [23] {12}
Jefferson	19,348	19,704	20,106	20,358	21,136 (4,227) [1,015] {507}	21,910 (4,382) [1,052] {526}	22,681 (4,536) [1,089] {544}
Larimer	9,545	9,726	9,946	10,115	10,543 (2,109) [506] {253}	10,969 (2,194) [527] {263}	11,393 (2,279) [547] {273}
Pueblo	7,602	7,860	8,077	8,269	8,766 (1,753) [421] {210}	9,270 (1,854) [445] {222}	9,781 (1,956) [469] {235}
Weld	13,111	13,353	13,620	13,813	14,370 (2,874) [690] {345}	14,927 (2,985) [717] {358}	15,484 (3,097) [743] {372}

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.