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

Date: 11/16/20

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 11/16/20 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.

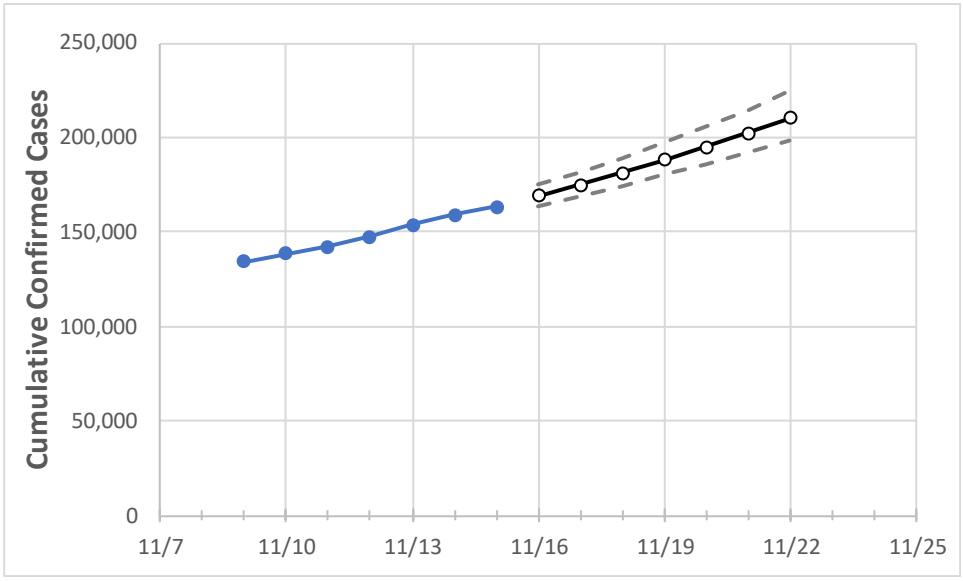
IEM's Modeling Lead

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:						
	11/12	11/13	11/14	11/15	11/16	11/17	11/18	11/19	11/20	11/21	11/22
Colorado	147,599	154,038	159,234	163,417	169,049	175,013	181,328	188,013	195,089	202,576	210,495

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:						
	11/12	11/13	11/14	11/15	11/16	11/17	11/18	11/19	11/20	11/21	11/22
Adams	20,346	21,175	21,789	22,149	22,755	23,385	24,040	24,721	25,429	26,165	26,930
Arapahoe	18,205	18,935	19,430	19,897	20,515	21,168	21,856	22,582	23,347	24,154	25,005
Boulder	7,685	7,974	8,266	8,435	8,716	9,019	9,346	9,698	10,078	10,488	10,929
Denver	25,544	26,396	26,988	27,719	28,504	29,328	30,194	31,103	32,057	33,059	34,111
Douglas	6,291	6,611	6,892	7,100	7,381	7,679	7,996	8,331	8,687	9,065	9,464
Eagle	1,789	1,812	1,853	1,882	1,921	1,964	2,010	2,060	2,114	2,172	2,235
El Paso	16,236	17,127	17,779	18,170	18,871	19,618	20,413	21,260	22,161	23,121	24,141
Gunnison	394	401	404	405	411	417	424	432	441	451	462
Jefferson	13,145	13,667	14,159	14,580	15,112	15,675	16,270	16,898	17,562	18,263	19,004
Larimer	6,195	6,376	6,707	6,925	7,175	7,442	7,727	8,031	8,354	8,700	9,067
Pueblo	3,982	4,267	4,585	4,860	5,151	5,467	5,812	6,187	6,595	7,038	7,520
Weld	8,881	9,168	9,511	9,844	10,188	10,557	10,952	11,374	11,825	12,307	12,823

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:		
	11/12	11/13	11/14	11/15	11/17	11/19	11/21
Adams	20,346	21,175	21,789	22,149	23,385 (4,677) [1,122] {561}	24,721 (4,944) [1,187] {593}	26,165 (5,233) [1,256] {628}
Arapahoe	18,205	18,935	19,430	19,897	21,168 (4,234) [1,016] {508}	22,582 (4,516) [1,084] {542}	24,154 (4,831) [1,159] {580}
Boulder	7,685	7,974	8,266	8,435	9,019 (1,804) [433] {216}	9,698 (1,940) [466] {233}	10,488 (2,098) [503] {252}
Denver	25,544	26,396	26,988	27,719	29,328 (5,866) [1,408] {704}	31,103 (6,221) [1,493] {746}	33,059 (6,612) [1,587] {793}
Douglas	6,291	6,611	6,892	7,100	7,679 (1,536) [369] {184}	8,331 (1,666) [400] {200}	9,065 (1,813) [435] {218}
Eagle	1,789	1,812	1,853	1,882	1,964 (393) [94] {47}	2,060 (412) [99] {49}	2,172 (434) [104] {52}
El Paso	16,236	17,127	17,779	18,170	19,618 (3,924) [942] {471}	21,260 (4,252) [1,020] {510}	23,121 (4,624) [1,110] {555}
Gunnison	394	401	404	405	417 (83) [20] {10}	432 (86) [21] {10}	451 (90) [22] {11}
Jefferson	13,145	13,667	14,159	14,580	15,675 (3,135) [752] {376}	16,898 (3,380) [811] {406}	18,263 (3,653) [877] {438}
Larimer	6,195	6,376	6,707	6,925	7,442 (1,488) [357] {179}	8,031 (1,606) [385] {193}	8,700 (1,740) [418] {209}
Pueblo	3,982	4,267	4,585	4,860	5,467 (1,093) [262] {131}	6,187 (1,237) [297] {148}	7,038 (1,408) [338] {169}
Weld	8,881	9,168	9,511	9,844	10,557 (2,111) [507] {253}	11,374 (2,275) [546] {273}	12,307 (2,461) [591] {295}

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.