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

Date: 5/20/21

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 5/20/21 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.

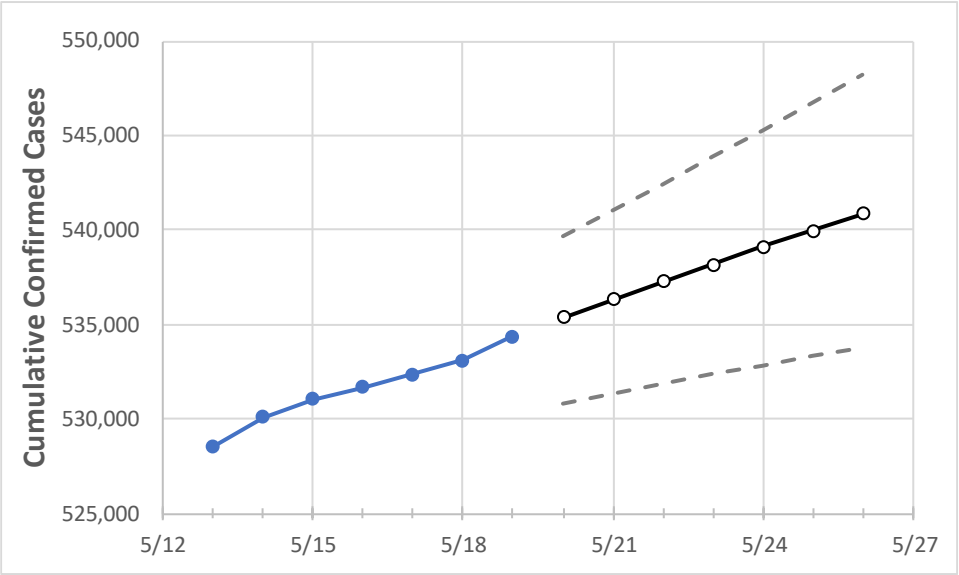
IEM's Modeling Lead

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:						
	5/16	5/17	5/18	5/19	5/20	5/21	5/22	5/23	5/24	5/25	5/26
Colorado	531,700	532,389	533,119	534,364	535,352	536,329	537,257	538,180	539,101	539,989	540,842

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 10%, and are often within 5%, of actual confirmed cases.

Colorado Counties

	Actual Confirmed Cases On:				Projected Cases For:						
	5/16	5/17	5/18	5/19	5/20	5/21	5/22	5/23	5/24	5/25	5/26
Adams	58,669	58,722	58,802	58,991	59,122	59,247	59,374	59,500	59,623	59,744	59,862
Arapahoe	60,158	60,214	60,297	60,498	60,623	60,753	60,877	61,006	61,129	61,243	61,360
Boulder	23,396	23,412	23,425	23,453	23,471	23,488	23,504	23,519	23,533	23,547	23,560
Denver	72,338	72,378	72,418	72,484	72,560	72,631	72,699	72,766	72,833	72,896	72,957
Douglas	28,967	29,011	29,036	29,091	29,133	29,173	29,210	29,250	29,290	29,327	29,361
Eagle	6,297	6,298	6,298	6,302	6,304	6,307	6,309	6,311	6,313	6,315	6,317
El Paso	67,698	67,882	68,078	68,304	68,507	68,706	68,905	69,096	69,288	69,477	69,667
Gunnison	1,344	1,345	1,346	1,346	1,348	1,349	1,350	1,352	1,353	1,355	1,356
Jefferson	47,148	47,193	47,258	47,352	47,444	47,535	47,623	47,710	47,796	47,878	47,961
Larimer	26,483	26,539	26,572	26,628	26,675	26,722	26,766	26,810	26,853	26,893	26,931
Pueblo	18,747	18,770	18,786	18,818	18,839	18,860	18,878	18,895	18,911	18,926	18,940
Weld	31,829	31,890	31,944	32,012	32,078	32,144	32,207	32,269	32,331	32,391	32,447

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:		
	5/16	5/17	5/18	5/19	5/21	5/23	5/25
Adams	58,669	58,722	58,802	58,991	59,247 (11,849) [2,844] {1,422}	59,500 (11,900) [2,856] {1,428}	59,744 (11,949) [2,868] {1,434}
Arapahoe	60,158	60,214	60,297	60,498	60,753 (12,151) [2,916] {1,458}	61,006 (12,201) [2,928] {1,464}	61,243 (12,249) [2,940] {1,470}
Boulder	23,396	23,412	23,425	23,453	23,488 (4,698) [1,127] {564}	23,519 (4,704) [1,129] {564}	23,547 (4,709) [1,130] {565}
Denver	72,338	72,378	72,418	72,484	72,631 (14,526) [3,486] {1,743}	72,766 (14,553) [3,493] {1,746}	72,896 (14,579) [3,499] {1,749}
Douglas	28,967	29,011	29,036	29,091	29,173 (5,835) [1,400] {700}	29,250 (5,850) [1,404] {702}	29,327 (5,865) [1,408] {704}
Eagle	6,297	6,298	6,298	6,302	6,307 (1,261) [303] {151}	6,311 (1,262) [303] {151}	6,315 (1,263) [303] {152}
El Paso	67,698	67,882	68,078	68,304	68,706 (13,741) [3,298] {1,649}	69,096 (13,819) [3,317] {1,658}	69,477 (13,895) [3,335] {1,667}
Gunnison	1,344	1,345	1,346	1,346	1,349 (270) [65] {32}	1,352 (270) [65] {32}	1,355 (271) [65] {33}
Jefferson	47,148	47,193	47,258	47,352	47,535 (9,507) [2,282] {1,141}	47,710 (9,542) [2,290] {1,145}	47,878 (9,576) [2,298] {1,149}
Larimer	26,483	26,539	26,572	26,628	26,722 (5,344) [1,283] {641}	26,810 (5,362) [1,287] {643}	26,893 (5,379) [1,291] {645}
Pueblo	18,747	18,770	18,786	18,818	18,860 (3,772) [905] {453}	18,895 (3,779) [907] {453}	18,926 (3,785) [908] {454}
Weld	31,829	31,890	31,944	32,012	32,144 (6,429) [1,543] {771}	32,269 (6,454) [1,549] {774}	32,391 (6,478) [1,555] {777}

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.