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

Date: 5/13/21

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 5/13/21 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.

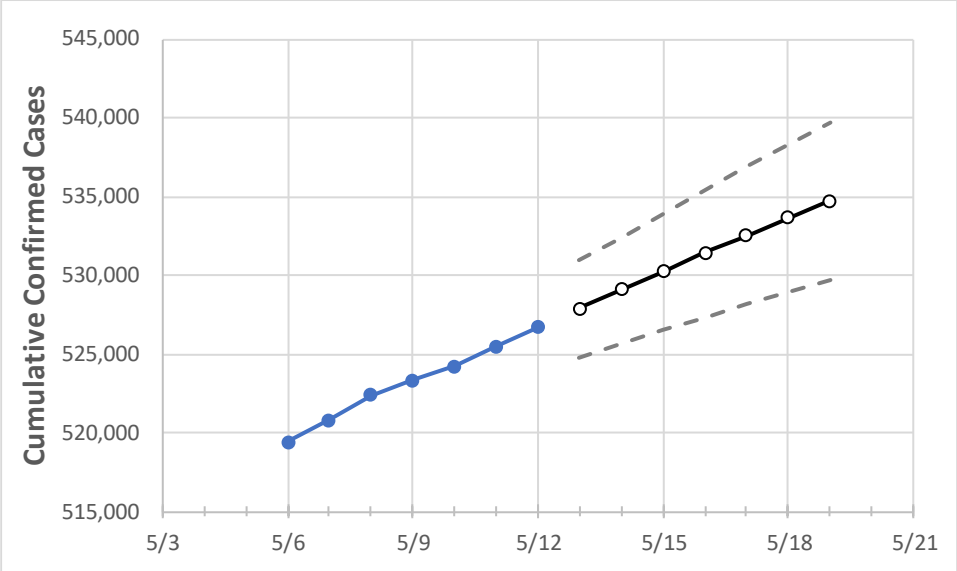
IEM's Modeling Lead

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:						
	5/9	5/10	5/11	5/12	5/13	5/14	5/15	5/16	5/17	5/18	5/19
Colorado	523,309	524,190	525,474	526,687	527,894	529,088	530,264	531,408	532,529	533,631	534,717

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:						
	5/9	5/10	5/11	5/12	5/13	5/14	5/15	5/16	5/17	5/18	5/19
Adams	57,574	57,676	57,906	58,066	58,225	58,381	58,538	58,696	58,849	59,000	59,155
Arapahoe	59,043	59,127	59,358	59,502	59,652	59,798	59,943	60,087	60,229	60,366	60,503
Boulder	23,229	23,255	23,275	23,300	23,333	23,365	23,394	23,423	23,450	23,478	23,503
Denver	71,613	71,672	71,793	71,870	71,974	72,073	72,173	72,268	72,360	72,450	72,536
Douglas	28,523	28,581	28,646	28,702	28,763	28,823	28,883	28,938	28,990	29,040	29,089
Eagle	6,268	6,274	6,279	6,279	6,285	6,290	6,296	6,301	6,306	6,311	6,316
El Paso	66,144	66,374	66,538	66,796	67,038	67,283	67,520	67,763	68,001	68,242	68,483
Gunnison	1,332	1,333	1,334	1,334	1,335	1,336	1,337	1,338	1,338	1,339	1,340
Jefferson	46,262	46,336	46,500	46,622	46,744	46,860	46,977	47,092	47,201	47,306	47,416
Larimer	26,078	26,123	26,171	26,243	26,301	26,359	26,416	26,469	26,521	26,573	26,623
Pueblo	18,498	18,534	18,566	18,609	18,670	18,727	18,785	18,840	18,895	18,950	19,002
Weld	31,272	31,336	31,395	31,467	31,540	31,614	31,686	31,759	31,831	31,901	31,968

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:		
	5/9	5/10	5/11	5/12	5/14	5/16	5/18
Adams	57,574	57,676	57,906	58,066	58,381 (11,676) [2,802] {1,401}	58,696 (11,739) [2,817] {1,409}	59,000 (11,800) [2,832] {1,416}
Arapahoe	59,043	59,127	59,358	59,502	59,798 (11,960) [2,870] {1,435}	60,087 (12,017) [2,884] {1,442}	60,366 (12,073) [2,898] {1,449}
Boulder	23,229	23,255	23,275	23,300	23,365 (4,673) [1,121] {561}	23,423 (4,685) [1,124] {562}	23,478 (4,696) [1,127] {563}
Denver	71,613	71,672	71,793	71,870	72,073 (14,415) [3,460] {1,730}	72,268 (14,454) [3,469] {1,734}	72,450 (14,490) [3,478] {1,739}
Douglas	28,523	28,581	28,646	28,702	28,823 (5,765) [1,383] {692}	28,938 (5,788) [1,389] {695}	29,040 (5,808) [1,394] {697}
Eagle	6,268	6,274	6,279	6,279	6,290 (1,258) [302] {151}	6,301 (1,260) [302] {151}	6,311 (1,262) [303] {151}
El Paso	66,144	66,374	66,538	66,796	67,283 (13,457) [3,230] {1,615}	67,763 (13,553) [3,253] {1,626}	68,242 (13,648) [3,276] {1,638}
Gunnison	1,332	1,333	1,334	1,334	1,336 (267) [64] {32}	1,338 (268) [64] {32}	1,339 (268) [64] {32}
Jefferson	46,262	46,336	46,500	46,622	46,860 (9,372) [2,249] {1,125}	47,092 (9,418) [2,260] {1,130}	47,306 (9,461) [2,271] {1,135}
Larimer	26,078	26,123	26,171	26,243	26,359 (5,272) [1,265] {633}	26,469 (5,294) [1,271] {635}	26,573 (5,315) [1,276] {638}
Pueblo	18,498	18,534	18,566	18,609	18,727 (3,745) [899] {449}	18,840 (3,768) [904] {452}	18,950 (3,790) [910] {455}
Weld	31,272	31,336	31,395	31,467	31,614 (6,323) [1,517] {759}	31,759 (6,352) [1,524] {762}	31,901 (6,380) [1,531] {766}

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.