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

Date: 10/18/21

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 10/18/21 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.

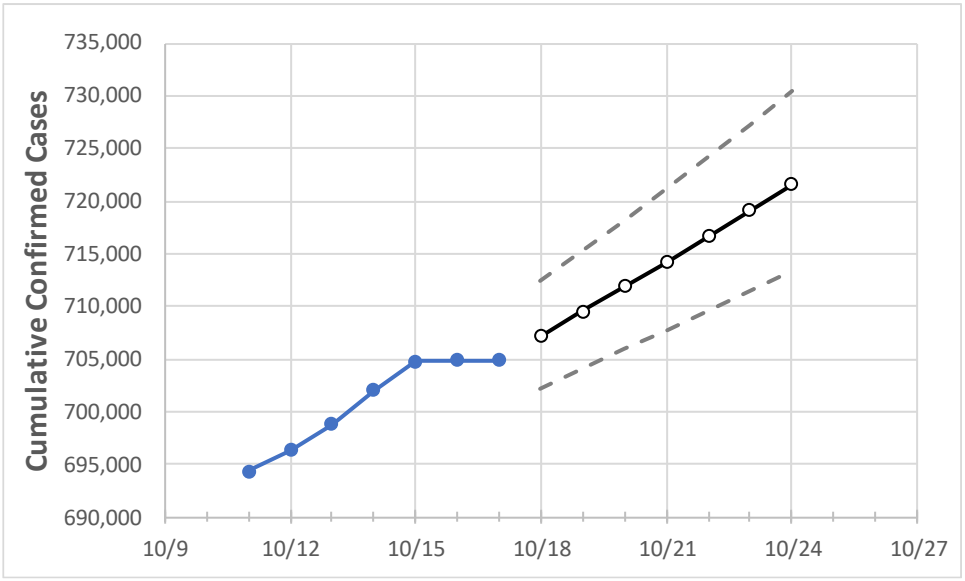
IEM's Modeling Lead

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:						
	10/14	10/15	10/16	10/17	10/18	10/19	10/20	10/21	10/22	10/23	10/24
Colorado	701,989	704,814	704,839	704,839	707,198	709,548	711,907	714,227	716,648	719,152	721,560

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:						
	10/14	10/15	10/16	10/17	10/18	10/19	10/20	10/21	10/22	10/23	10/24
Adams	73,101	73,358	73,358	73,358	73,583	73,810	74,044	74,284	74,533	74,784	75,045
Arapahoe	76,804	77,101	77,101	77,101	77,376	77,660	77,949	78,249	78,556	78,869	79,193
Boulder	29,757	29,863	29,863	29,863	29,968	30,072	30,180	30,290	30,402	30,515	30,636
Denver	88,667	88,868	88,868	88,868	89,108	89,344	89,585	89,829	90,077	90,338	90,589
Douglas	38,851	38,986	38,986	38,986	39,115	39,246	39,375	39,509	39,644	39,778	39,918
Eagle	8,121	8,140	8,140	8,140	8,158	8,175	8,193	8,210	8,228	8,247	8,266
El Paso	96,721	97,085	97,085	97,085	97,475	97,870	98,270	98,654	99,081	99,493	99,903
Gunnison	1,799	1,803	1,803	1,803	1,807	1,811	1,815	1,819	1,823	1,827	1,831
Jefferson	60,573	60,831	60,831	60,831	61,047	61,262	61,487	61,712	61,943	62,181	62,416
Larimer	37,237	37,381	37,381	37,381	37,550	37,719	37,896	38,076	38,255	38,441	38,631
Pueblo	23,849	23,954	23,954	23,954	24,074	24,202	24,328	24,460	24,596	24,736	24,882
Weld	44,203	44,381	44,381	44,381	44,575	44,768	44,965	45,164	45,369	45,579	45,789

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:		
	10/14	10/15	10/16	10/17	10/19	10/21	10/23
Adams	73,101	73,358	73,358	73,358	73,810 (14,762) [3,543] {1,771}	74,284 (14,857) [3,566] {1,783}	74,784 (14,957) [3,590] {1,795}
Arapahoe	76,804	77,101	77,101	77,101	77,660 (15,532) [3,728] {1,864}	78,249 (15,650) [3,756] {1,878}	78,869 (15,774) [3,786] {1,893}
Boulder	29,757	29,863	29,863	29,863	30,072 (6,014) [1,443] {722}	30,290 (6,058) [1,454] {727}	30,515 (6,103) [1,465] {732}
Denver	88,667	88,868	88,868	88,868	89,344 (17,869) [4,289] {2,144}	89,829 (17,966) [4,312] {2,156}	90,338 (18,068) [4,336] {2,168}
Douglas	38,851	38,986	38,986	38,986	39,246 (7,849) [1,884] {942}	39,509 (7,902) [1,896] {948}	39,778 (7,956) [1,909] {955}
Eagle	8,121	8,140	8,140	8,140	8,175 (1,635) [392] {196}	8,210 (1,642) [394] {197}	8,247 (1,649) [396] {198}
El Paso	96,721	97,085	97,085	97,085	97,870 (19,574) [4,698] {2,349}	98,654 (19,731) [4,735] {2,368}	99,493 (19,899) [4,776] {2,388}
Gunnison	1,799	1,803	1,803	1,803	1,811 (362) [87] {43}	1,819 (364) [87] {44}	1,827 (365) [88] {44}
Jefferson	60,573	60,831	60,831	60,831	61,262 (12,252) [2,941] {1,470}	61,712 (12,342) [2,962] {1,481}	62,181 (12,436) [2,985] {1,492}
Larimer	37,237	37,381	37,381	37,381	37,719 (7,544) [1,811] {905}	38,076 (7,615) [1,828] {914}	38,441 (7,688) [1,845] {923}
Pueblo	23,849	23,954	23,954	23,954	24,202 (4,840) [1,162] {581}	24,460 (4,892) [1,174] {587}	24,736 (4,947) [1,187] {594}
Weld	44,203	44,381	44,381	44,381	44,768 (8,954) [2,149] {1,074}	45,164 (9,033) [2,168] {1,084}	45,579 (9,116) [2,188] {1,094}

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.