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

Date: 6/16/21

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 6/16/21 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.

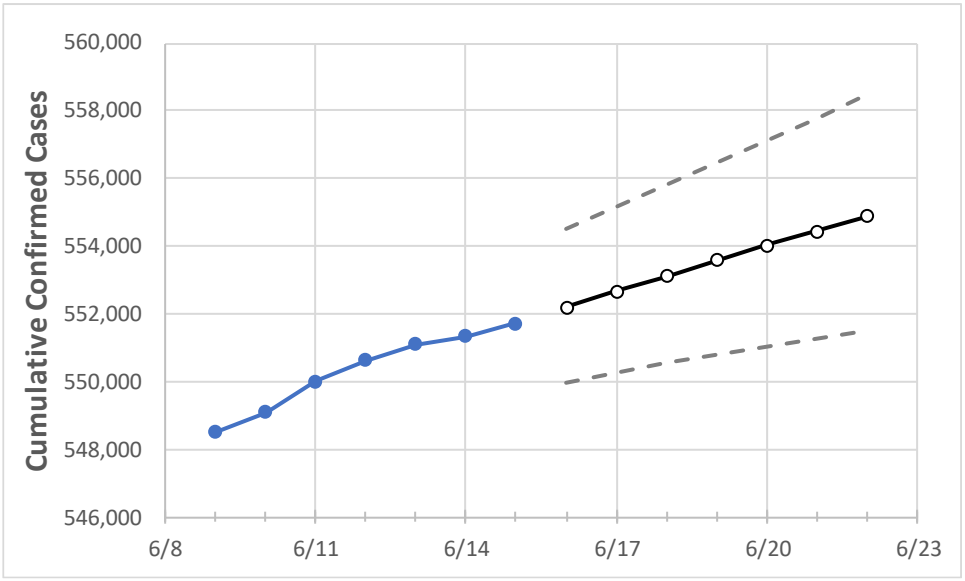
IEM's Modeling Lead

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:						
	6/12	6/13	6/14	6/15	6/16	6/17	6/18	6/19	6/20	6/21	6/22
Colorado	550,618	551,091	551,328	551,719	552,200	552,664	553,120	553,575	554,029	554,437	554,871

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:						
	6/12	6/13	6/14	6/15	6/16	6/17	6/18	6/19	6/20	6/21	6/22
Adams	60,332	60,369	60,397	60,442	60,478	60,513	60,546	60,579	60,612	60,643	60,674
Arapahoe	62,152	62,182	62,199	62,264	62,305	62,346	62,385	62,422	62,461	62,498	62,535
Boulder	23,850	23,855	23,861	23,870	23,881	23,892	23,903	23,913	23,924	23,934	23,943
Denver	73,831	73,876	73,893	73,927	73,978	74,029	74,078	74,128	74,178	74,224	74,272
Douglas	30,032	30,052	30,060	30,089	30,122	30,153	30,184	30,215	30,245	30,275	30,304
Eagle	6,340	6,341	6,341	6,340	6,342	6,344	6,345	6,347	6,349	6,351	6,352
El Paso	71,977	72,095	72,148	72,254	72,355	72,454	72,550	72,645	72,735	72,823	72,911
Gunnison	1,370	1,371	1,370	1,372	1,374	1,376	1,377	1,379	1,381	1,384	1,386
Jefferson	48,452	48,497	48,510	48,520	48,548	48,576	48,603	48,629	48,654	48,678	48,702
Larimer	27,326	27,338	27,356	27,390	27,413	27,436	27,458	27,480	27,502	27,524	27,546
Pueblo	19,369	19,406	19,409	19,387	19,409	19,430	19,452	19,473	19,496	19,518	19,540
Weld	33,043	33,063	33,084	33,107	33,135	33,162	33,189	33,215	33,241	33,265	33,289

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:		
	6/12	6/13	6/14	6/15	6/17	6/19	6/21
Adams	60,332	60,369	60,397	60,442	60,513 (12,103) [2,905] {1,452}	60,579 (12,116) [2,908] {1,454}	60,643 (12,129) [2,911] {1,455}
Arapahoe	62,152	62,182	62,199	62,264	62,346 (12,469) [2,993] {1,496}	62,422 (12,484) [2,996] {1,498}	62,498 (12,500) [3,000] {1,500}
Boulder	23,850	23,855	23,861	23,870	23,892 (4,778) [1,147] {573}	23,913 (4,783) [1,148] {574}	23,934 (4,787) [1,149] {574}
Denver	73,831	73,876	73,893	73,927	74,029 (14,806) [3,553] {1,777}	74,128 (14,826) [3,558] {1,779}	74,224 (14,845) [3,563] {1,781}
Douglas	30,032	30,052	30,060	30,089	30,153 (6,031) [1,447] {724}	30,215 (6,043) [1,450] {725}	30,275 (6,055) [1,453] {727}
Eagle	6,340	6,341	6,341	6,340	6,344 (1,269) [304] {152}	6,347 (1,269) [305] {152}	6,351 (1,270) [305] {152}
El Paso	71,977	72,095	72,148	72,254	72,454 (14,491) [3,478] {1,739}	72,645 (14,529) [3,487] {1,743}	72,823 (14,565) [3,496] {1,748}
Gunnison	1,370	1,371	1,370	1,372	1,376 (275) [66] {33}	1,379 (276) [66] {33}	1,384 (277) [66] {33}
Jefferson	48,452	48,497	48,510	48,520	48,576 (9,715) [2,332] {1,166}	48,629 (9,726) [2,334] {1,167}	48,678 (9,736) [2,337] {1,168}
Larimer	27,326	27,338	27,356	27,390	27,436 (5,487) [1,317] {658}	27,480 (5,496) [1,319] {660}	27,524 (5,505) [1,321] {661}
Pueblo	19,369	19,406	19,409	19,387	19,430 (3,886) [933] {466}	19,473 (3,895) [935] {467}	19,518 (3,904) [937] {468}
Weld	33,043	33,063	33,084	33,107	33,162 (6,632) [1,592] {796}	33,215 (6,643) [1,594] {797}	33,265 (6,653) [1,597] {798}

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.