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

Date: 7/7/21

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 7/7/21 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.

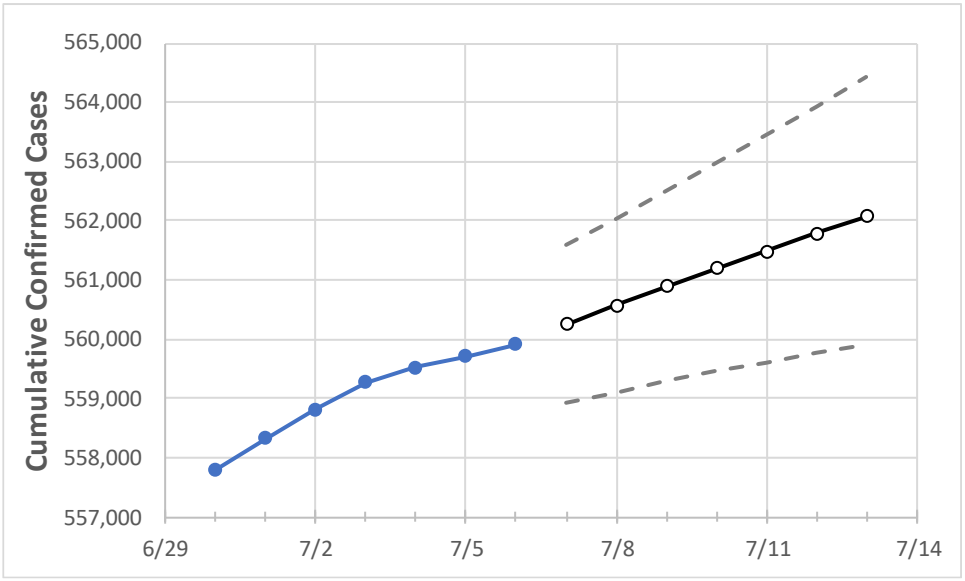
IEM's Modeling Lead

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:						
	7/3	7/4	7/5	7/6	7/7	7/8	7/9	7/10	7/11	7/12	7/13
Colorado	559,272	559,534	559,704	559,921	560,248	560,576	560,895	561,194	561,491	561,783	562,080

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:						
	7/3	7/4	7/5	7/6	7/7	7/8	7/9	7/10	7/11	7/12	7/13
Adams	61,013	61,035	61,047	61,063	61,087	61,111	61,136	61,159	61,181	61,204	61,226
Arapahoe	62,931	62,961	62,977	62,987	63,018	63,050	63,079	63,106	63,136	63,165	63,193
Boulder	24,038	24,045	24,054	24,059	24,070	24,081	24,092	24,103	24,114	24,125	24,136
Denver	74,473	74,495	74,504	74,519	74,542	74,564	74,586	74,606	74,627	74,646	74,665
Douglas	30,584	30,593	30,602	30,613	30,623	30,631	30,639	30,647	30,653	30,659	30,665
Eagle	6,366	6,368	6,369	6,369	6,370	6,372	6,373	6,375	6,376	6,378	6,379
El Paso	73,594	73,635	73,673	73,725	73,779	73,831	73,884	73,933	73,982	74,030	74,077
Gunnison	1,401	1,401	1,401	1,401	1,403	1,406	1,408	1,410	1,413	1,415	1,418
Jefferson	48,997	49,008	49,017	49,023	49,042	49,060	49,078	49,096	49,113	49,131	49,147
Larimer	27,797	27,820	27,831	27,845	27,866	27,886	27,906	27,926	27,946	27,966	27,986
Pueblo	19,624	19,628	19,633	19,640	19,646	19,651	19,657	19,662	19,667	19,671	19,676
Weld	33,542	33,557	33,569	33,592	33,612	33,631	33,651	33,670	33,689	33,707	33,725

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:		
	7/3	7/4	7/5	7/6	7/8	7/10	7/12
Adams	61,013	61,035	61,047	61,063	61,111 (12,222) [2,933] {1,467}	61,159 (12,232) [2,936] {1,468}	61,204 (12,241) [2,938] {1,469}
Arapahoe	62,931	62,961	62,977	62,987	63,050 (12,610) [3,026] {1,513}	63,106 (12,621) [3,029] {1,515}	63,165 (12,633) [3,032] {1,516}
Boulder	24,038	24,045	24,054	24,059	24,081 (4,816) [1,156] {578}	24,103 (4,821) [1,157] {578}	24,125 (4,825) [1,158] {579}
Denver	74,473	74,495	74,504	74,519	74,564 (14,913) [3,579] {1,790}	74,606 (14,921) [3,581] {1,791}	74,646 (14,929) [3,583] {1,791}
Douglas	30,584	30,593	30,602	30,613	30,631 (6,126) [1,470] {735}	30,647 (6,129) [1,471] {736}	30,659 (6,132) [1,472] {736}
Eagle	6,366	6,368	6,369	6,369	6,372 (1,274) [306] {153}	6,375 (1,275) [306] {153}	6,378 (1,276) [306] {153}
El Paso	73,594	73,635	73,673	73,725	73,831 (14,766) [3,544] {1,772}	73,933 (14,787) [3,549] {1,774}	74,030 (14,806) [3,553] {1,777}
Gunnison	1,401	1,401	1,401	1,401	1,406 (281) [67] {34}	1,410 (282) [68] {34}	1,415 (283) [68] {34}
Jefferson	48,997	49,008	49,017	49,023	49,060 (9,812) [2,355] {1,177}	49,096 (9,819) [2,357] {1,178}	49,131 (9,826) [2,358] {1,179}
Larimer	27,797	27,820	27,831	27,845	27,886 (5,577) [1,339] {669}	27,926 (5,585) [1,340] {670}	27,966 (5,593) [1,342] {671}
Pueblo	19,624	19,628	19,633	19,640	19,651 (3,930) [943] {472}	19,662 (3,932) [944] {472}	19,671 (3,934) [944] {472}
Weld	33,542	33,557	33,569	33,592	33,631 (6,726) [1,614] {807}	33,670 (6,734) [1,616] {808}	33,707 (6,741) [1,618] {809}

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.