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

Date: 8/30/21

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 8/30/21 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.

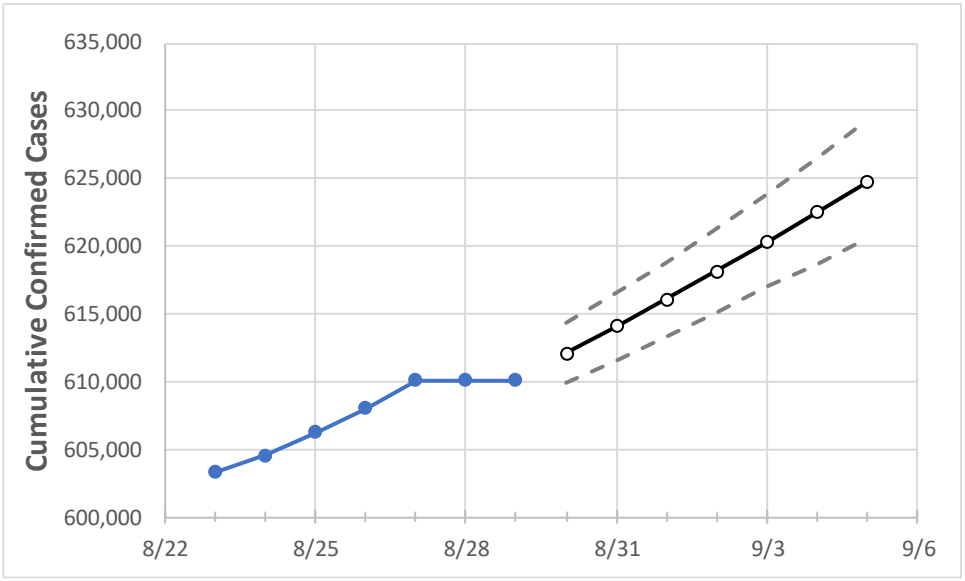
IEM's Modeling Lead

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:						
	8/26	8/27	8/28	8/29	8/30	8/31	9/1	9/2	9/3	9/4	9/5
Colorado	608,047	610,127	610,127	610,127	612,069	614,050	616,098	618,145	620,301	622,536	624,724

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:						
	8/26	8/27	8/28	8/29	8/30	8/31	9/1	9/2	9/3	9/4	9/5
Adams	65,647	65,856	65,856	65,856	66,071	66,286	66,513	66,747	66,988	67,242	67,498
Arapahoe	67,962	68,244	68,244	68,244	68,452	68,659	68,870	69,100	69,322	69,555	69,786
Boulder	26,090	26,146	26,146	26,146	26,215	26,285	26,358	26,430	26,506	26,582	26,661
Denver	79,979	80,220	80,220	80,220	80,436	80,653	80,870	81,101	81,335	81,576	81,823
Douglas	33,526	33,677	33,677	33,677	33,814	33,953	34,097	34,246	34,400	34,558	34,716
Eagle	7,094	7,114	7,114	7,114	7,143	7,175	7,208	7,239	7,272	7,305	7,337
El Paso	81,239	81,527	81,527	81,527	81,776	82,027	82,278	82,537	82,806	83,074	83,352
Gunnison	1,534	1,535	1,535	1,535	1,544	1,553	1,563	1,573	1,584	1,595	1,606
Jefferson	52,962	53,088	53,088	53,088	53,233	53,378	53,525	53,678	53,832	53,993	54,153
Larimer	31,094	31,232	31,232	31,232	31,382	31,536	31,695	31,855	32,027	32,201	32,379
Pueblo	20,633	20,698	20,698	20,698	20,739	20,780	20,823	20,866	20,911	20,958	21,003
Weld	36,885	37,037	37,037	37,037	37,201	37,371	37,545	37,725	37,914	38,109	38,310

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:		
	8/26	8/27	8/28	8/29	8/31	9/2	9/4
Adams	65,647	65,856	65,856	65,856	66,286 (13,257) [3,182] {1,591}	66,747 (13,349) [3,204] {1,602}	67,242 (13,448) [3,228] {1,614}
Arapahoe	67,962	68,244	68,244	68,244	68,659 (13,732) [3,296] {1,648}	69,100 (13,820) [3,317] {1,658}	69,555 (13,911) [3,339] {1,669}
Boulder	26,090	26,146	26,146	26,146	26,285 (5,257) [1,262] {631}	26,430 (5,286) [1,269] {634}	26,582 (5,316) [1,276] {638}
Denver	79,979	80,220	80,220	80,220	80,653 (16,131) [3,871] {1,936}	81,101 (16,220) [3,893] {1,946}	81,576 (16,315) [3,916] {1,958}
Douglas	33,526	33,677	33,677	33,677	33,953 (6,791) [1,630] {815}	34,246 (6,849) [1,644] {822}	34,558 (6,912) [1,659] {829}
Eagle	7,094	7,114	7,114	7,114	7,175 (1,435) [344] {172}	7,239 (1,448) [347] {174}	7,305 (1,461) [351] {175}
El Paso	81,239	81,527	81,527	81,527	82,027 (16,405) [3,937] {1,969}	82,537 (16,507) [3,962] {1,981}	83,074 (16,615) [3,988] {1,994}
Gunnison	1,534	1,535	1,535	1,535	1,553 (311) [75] {37}	1,573 (315) [76] {38}	1,595 (319) [77] {38}
Jefferson	52,962	53,088	53,088	53,088	53,378 (10,676) [2,562] {1,281}	53,678 (10,736) [2,577] {1,288}	53,993 (10,799) [2,592] {1,296}
Larimer	31,094	31,232	31,232	31,232	31,536 (6,307) [1,514] {757}	31,855 (6,371) [1,529] {765}	32,201 (6,440) [1,546] {773}
Pueblo	20,633	20,698	20,698	20,698	20,780 (4,156) [997] {499}	20,866 (4,173) [1,002] {501}	20,958 (4,192) [1,006] {503}
Weld	36,885	37,037	37,037	37,037	37,371 (7,474) [1,794] {897}	37,725 (7,545) [1,811] {905}	38,109 (7,622) [1,829] {915}

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.