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

Date: 3/8/21

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 3/8/21 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.

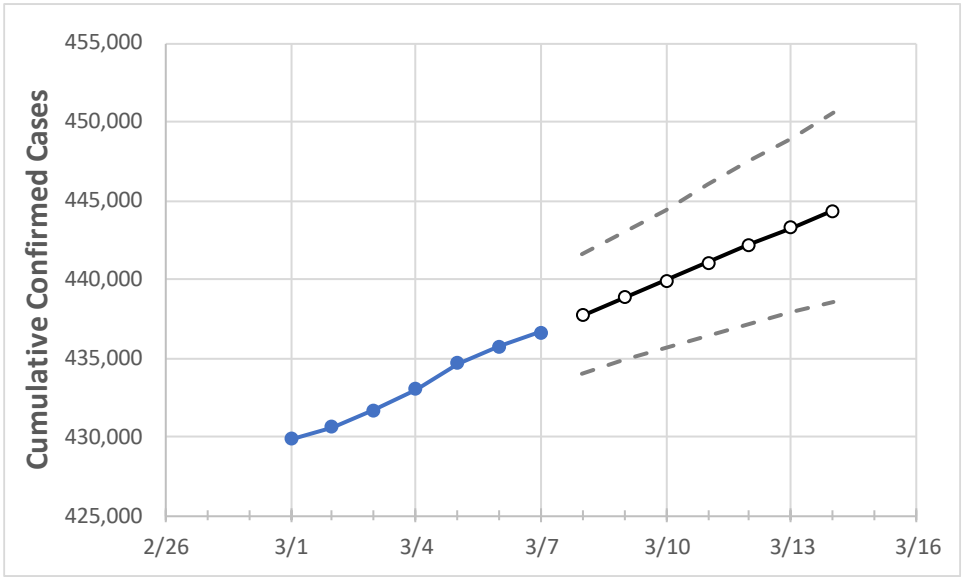
IEM's Modeling Lead

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:						
	3/4	3/5	3/6	3/7	3/8	3/9	3/10	3/11	3/12	3/13	3/14
Colorado	433,021	434,654	435,762	436,612	437,724	438,832	439,930	441,044	442,166	443,261	444,365

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:						
	3/4	3/5	3/6	3/7	3/8	3/9	3/10	3/11	3/12	3/13	3/14
Adams	48,876	49,045	49,123	49,215	49,325	49,440	49,555	49,673	49,790	49,905	50,027
Arapahoe	48,927	49,139	49,234	49,321	49,436	49,555	49,670	49,780	49,891	50,006	50,120
Boulder	19,039	19,098	19,148	19,193	19,241	19,289	19,338	19,385	19,434	19,484	19,531
Denver	60,121	60,389	60,505	60,614	60,753	60,890	61,030	61,174	61,315	61,462	61,612
Douglas	21,648	21,786	21,897	21,966	22,050	22,133	22,220	22,305	22,392	22,479	22,567
Eagle	5,167	5,198	5,224	5,242	5,267	5,293	5,318	5,343	5,369	5,394	5,419
El Paso	52,619	52,787	52,976	53,078	53,228	53,380	53,533	53,689	53,843	53,998	54,153
Gunnison	1,211	1,212	1,212	1,212	1,214	1,215	1,217	1,218	1,219	1,221	1,222
Jefferson	37,583	37,809	37,933	38,033	38,151	38,270	38,390	38,513	38,639	38,768	38,900
Larimer	20,370	20,441	20,524	20,589	20,665	20,741	20,817	20,892	20,967	21,043	21,119
Pueblo	15,134	15,167	15,177	15,186	15,206	15,225	15,244	15,262	15,282	15,300	15,319
Weld	25,779	25,856	25,926	25,983	26,055	26,125	26,198	26,272	26,345	26,419	26,492

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:		
	3/4	3/5	3/6	3/7	3/9	3/11	3/13
Adams	48,876	49,045	49,123	49,215	49,440 (9,888) [2,373] {1,187}	49,673 (9,935) [2,384] {1,192}	49,905 (9,981) [2,395] {1,198}
Arapahoe	48,927	49,139	49,234	49,321	49,555 (9,911) [2,379] {1,189}	49,780 (9,956) [2,389] {1,195}	50,006 (10,001) [2,400] {1,200}
Boulder	19,039	19,098	19,148	19,193	19,289 (3,858) [926] {463}	19,385 (3,877) [931] {465}	19,484 (3,897) [935] {468}
Denver	60,121	60,389	60,505	60,614	60,890 (12,178) [2,923] {1,461}	61,174 (12,235) [2,936] {1,468}	61,462 (12,292) [2,950] {1,475}
Douglas	21,648	21,786	21,897	21,966	22,133 (4,427) [1,062] {531}	22,305 (4,461) [1,071] {535}	22,479 (4,496) [1,079] {539}
Eagle	5,167	5,198	5,224	5,242	5,293 (1,059) [254] {127}	5,343 (1,069) [256] {128}	5,394 (1,079) [259] {129}
El Paso	52,619	52,787	52,976	53,078	53,380 (10,676) [2,562] {1,281}	53,689 (10,738) [2,577] {1,289}	53,998 (10,800) [2,592] {1,296}
Gunnison	1,211	1,212	1,212	1,212	1,215 (243) [58] {29}	1,218 (244) [58] {29}	1,221 (244) [59] {29}
Jefferson	37,583	37,809	37,933	38,033	38,270 (7,654) [1,837] {918}	38,513 (7,703) [1,849] {924}	38,768 (7,754) [1,861] {930}
Larimer	20,370	20,441	20,524	20,589	20,741 (4,148) [996] {498}	20,892 (4,178) [1,003] {501}	21,043 (4,209) [1,010] {505}
Pueblo	15,134	15,167	15,177	15,186	15,225 (3,045) [731] {365}	15,262 (3,052) [733] {366}	15,300 (3,060) [734] {367}
Weld	25,779	25,856	25,926	25,983	26,125 (5,225) [1,254] {627}	26,272 (5,254) [1,261] {631}	26,419 (5,284) [1,268] {634}

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.