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

Date: 3/5/21

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 3/5/21 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.

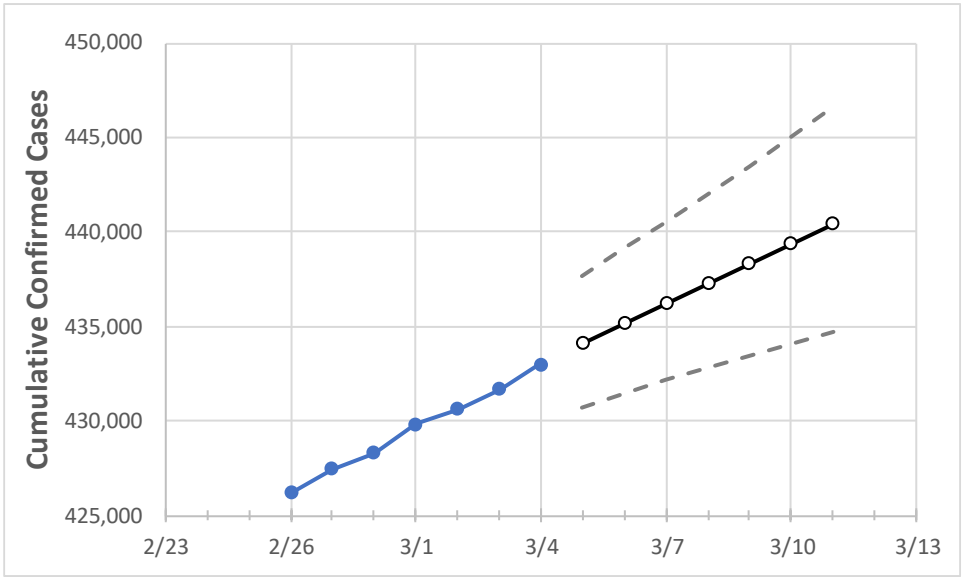
IEM's Modeling Lead

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:						
	3/1	3/2	3/3	3/4	3/5	3/6	3/7	3/8	3/9	3/10	3/11
Colorado	429,839	430,615	431,670	433,021	434,098	435,152	436,199	437,261	438,342	439,394	440,442

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:						
	3/1	3/2	3/3	3/4	3/5	3/6	3/7	3/8	3/9	3/10	3/11
Adams	48,560	48,635	48,730	48,876	48,987	49,100	49,216	49,331	49,448	49,566	49,688
Arapahoe	48,640	48,715	48,795	48,927	49,038	49,150	49,263	49,373	49,483	49,595	49,704
Boulder	18,888	18,910	18,975	19,039	19,086	19,134	19,182	19,228	19,274	19,321	19,366
Denver	59,779	59,842	59,959	60,121	60,252	60,383	60,514	60,644	60,770	60,903	61,034
Douglas	21,402	21,463	21,552	21,648	21,721	21,792	21,862	21,933	22,005	22,076	22,149
Eagle	5,088	5,120	5,148	5,167	5,192	5,218	5,243	5,268	5,294	5,319	5,345
El Paso	52,145	52,264	52,422	52,619	52,773	52,929	53,086	53,247	53,408	53,565	53,727
Gunnison	1,205	1,207	1,211	1,211	1,213	1,215	1,217	1,219	1,221	1,222	1,224
Jefferson	37,323	37,380	37,452	37,583	37,676	37,771	37,863	37,957	38,048	38,142	38,235
Larimer	20,153	20,234	20,300	20,370	20,447	20,526	20,606	20,685	20,765	20,843	20,925
Pueblo	15,046	15,058	15,110	15,134	15,153	15,171	15,189	15,207	15,224	15,241	15,257
Weld	25,562	25,613	25,698	25,779	25,848	25,919	25,991	26,062	26,135	26,209	26,282

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:		
	3/1	3/2	3/3	3/4	3/6	3/8	3/10
Adams	48,560	48,635	48,730	48,876	49,100 (9,820) [2,357] {1,178}	49,331 (9,866) [2,368] {1,184}	49,566 (9,913) [2,379] {1,190}
Arapahoe	48,640	48,715	48,795	48,927	49,150 (9,830) [2,359] {1,180}	49,373 (9,875) [2,370] {1,185}	49,595 (9,919) [2,381] {1,190}
Boulder	18,888	18,910	18,975	19,039	19,134 (3,827) [918] {459}	19,228 (3,846) [923] {461}	19,321 (3,864) [927] {464}
Denver	59,779	59,842	59,959	60,121	60,383 (12,077) [2,898] {1,449}	60,644 (12,129) [2,911] {1,455}	60,903 (12,181) [2,923] {1,462}
Douglas	21,402	21,463	21,552	21,648	21,792 (4,358) [1,046] {523}	21,933 (4,387) [1,053] {526}	22,076 (4,415) [1,060] {530}
Eagle	5,088	5,120	5,148	5,167	5,218 (1,044) [250] {125}	5,268 (1,054) [253] {126}	5,319 (1,064) [255] {128}
El Paso	52,145	52,264	52,422	52,619	52,929 (10,586) [2,541] {1,270}	53,247 (10,649) [2,556] {1,278}	53,565 (10,713) [2,571] {1,286}
Gunnison	1,205	1,207	1,211	1,211	1,215 (243) [58] {29}	1,219 (244) [59] {29}	1,222 (244) [59] {29}
Jefferson	37,323	37,380	37,452	37,583	37,771 (7,554) [1,813] {907}	37,957 (7,591) [1,822] {911}	38,142 (7,628) [1,831] {915}
Larimer	20,153	20,234	20,300	20,370	20,526 (4,105) [985] {493}	20,685 (4,137) [993] {496}	20,843 (4,169) [1,000] {500}
Pueblo	15,046	15,058	15,110	15,134	15,171 (3,034) [728] {364}	15,207 (3,041) [730] {365}	15,241 (3,048) [732] {366}
Weld	25,562	25,613	25,698	25,779	25,919 (5,184) [1,244] {622}	26,062 (5,212) [1,251] {625}	26,209 (5,242) [1,258] {629}

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.