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

Date: 10/13/21

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 10/13/21 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.

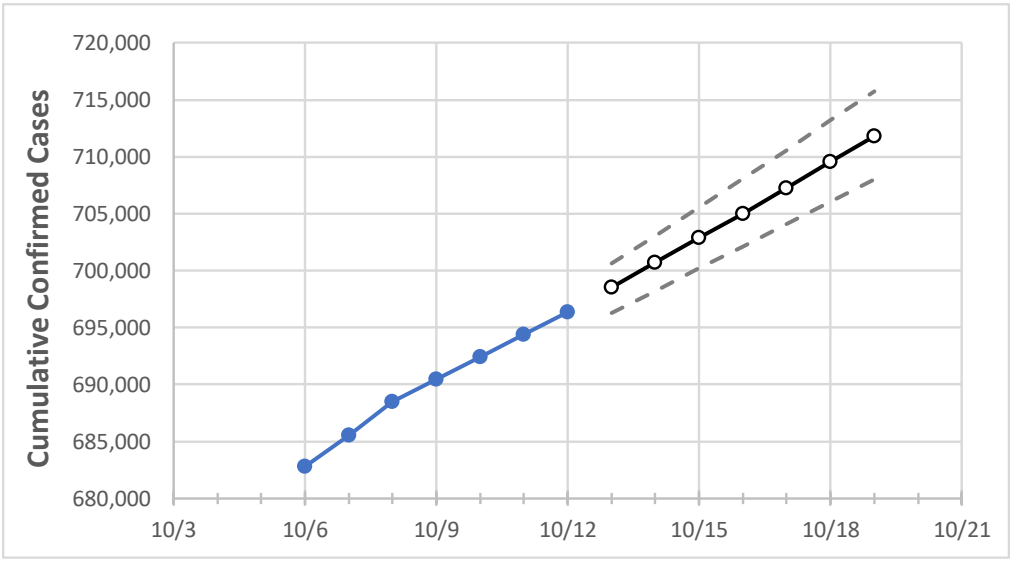
IEM's Modeling Lead

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:						
	10/9	10/10	10/11	10/12	10/13	10/14	10/15	10/16	10/17	10/18	10/19
Colorado	690,426	692,388	694,349	696,349	698,515	700,669	702,854	705,008	707,252	709,523	711,771

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:						
	10/9	10/10	10/11	10/12	10/13	10/14	10/15	10/16	10/17	10/18	10/19
Adams	72,149	72,323	72,496	72,612	72,765	72,922	73,081	73,240	73,401	73,566	73,732
Arapahoe	75,696	75,910	76,125	76,331	76,542	76,751	76,964	77,183	77,398	77,626	77,851
Boulder	29,319	29,393	29,466	29,542	29,625	29,707	29,795	29,878	29,966	30,055	30,142
Denver	87,624	87,808	87,991	88,190	88,393	88,599	88,805	89,016	89,228	89,441	89,661
Douglas	38,296	38,397	38,497	38,599	38,711	38,822	38,935	39,051	39,165	39,280	39,394
Eagle	8,036	8,047	8,058	8,070	8,083	8,096	8,109	8,122	8,135	8,148	8,160
El Paso	94,966	95,273	95,581	95,848	96,187	96,536	96,874	97,227	97,571	97,926	98,279
Gunnison	1,780	1,783	1,785	1,788	1,792	1,795	1,798	1,802	1,805	1,808	1,812
Jefferson	59,642	59,795	59,947	60,164	60,335	60,511	60,682	60,856	61,030	61,210	61,387
Larimer	36,443	36,568	36,692	36,835	36,973	37,109	37,249	37,388	37,528	37,671	37,815
Pueblo	23,322	23,398	23,473	23,576	23,660	23,745	23,833	23,922	24,012	24,103	24,195
Weld	43,336	43,487	43,637	43,770	43,925	44,079	44,234	44,390	44,549	44,709	44,866

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:		
	10/9	10/10	10/11	10/12	10/14	10/16	10/18
Adams	72,149	72,323	72,496	72,612	72,922 (14,584) [3,500] {1,750}	73,240 (14,648) [3,516] {1,758}	73,566 (14,713) [3,531] {1,766}
Arapahoe	75,696	75,910	76,125	76,331	76,751 (15,350) [3,684] {1,842}	77,183 (15,437) [3,705] {1,852}	77,626 (15,525) [3,726] {1,863}
Boulder	29,319	29,393	29,466	29,542	29,707 (5,941) [1,426] {713}	29,878 (5,976) [1,434] {717}	30,055 (6,011) [1,443] {721}
Denver	87,624	87,808	87,991	88,190	88,599 (17,720) [4,253] {2,126}	89,016 (17,803) [4,273] {2,136}	89,441 (17,888) [4,293] {2,147}
Douglas	38,296	38,397	38,497	38,599	38,822 (7,764) [1,863] {932}	39,051 (7,810) [1,874] {937}	39,280 (7,856) [1,885] {943}
Eagle	8,036	8,047	8,058	8,070	8,096 (1,619) [389] {194}	8,122 (1,624) [390] {195}	8,148 (1,630) [391] {196}
El Paso	94,966	95,273	95,581	95,848	96,536 (19,307) [4,634] {2,317}	97,227 (19,445) [4,667] {2,333}	97,926 (19,585) [4,700] {2,350}
Gunnison	1,780	1,783	1,785	1,788	1,795 (359) [86] {43}	1,802 (360) [86] {43}	1,808 (362) [87] {43}
Jefferson	59,642	59,795	59,947	60,164	60,511 (12,102) [2,905] {1,452}	60,856 (12,171) [2,921] {1,461}	61,210 (12,242) [2,938] {1,469}
Larimer	36,443	36,568	36,692	36,835	37,109 (7,422) [1,781] {891}	37,388 (7,478) [1,795] {897}	37,671 (7,534) [1,808] {904}
Pueblo	23,322	23,398	23,473	23,576	23,745 (4,749) [1,140] {570}	23,922 (4,784) [1,148] {574}	24,103 (4,821) [1,157] {578}
Weld	43,336	43,487	43,637	43,770	44,079 (8,816) [2,116] {1,058}	44,390 (8,878) [2,131] {1,065}	44,709 (8,942) [2,146] {1,073}

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.