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

Date: 12/1/21

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 12/1/21 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.

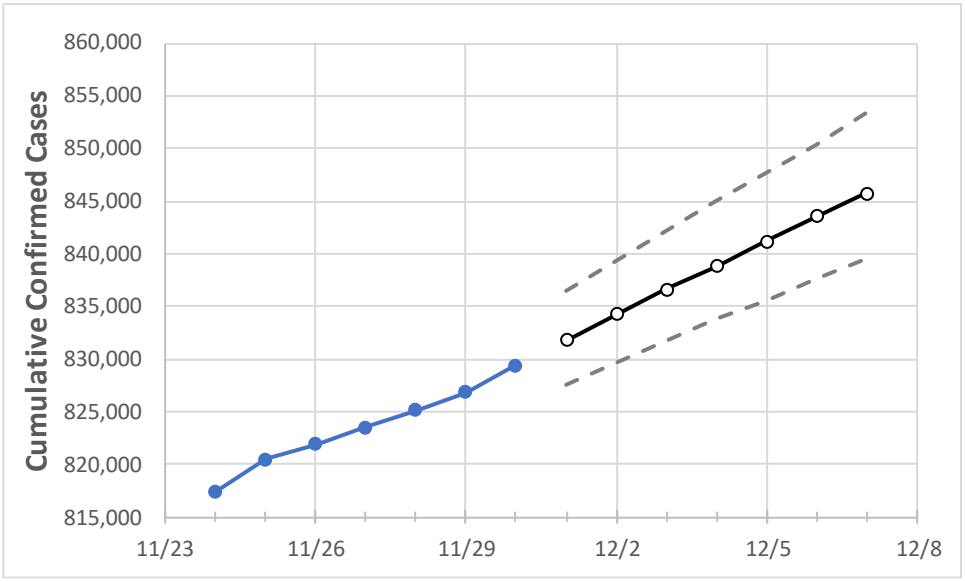
IEM's Modeling Lead

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:						
	11/27	11/28	11/29	11/30	12/1	12/2	12/3	12/4	12/5	12/6	12/7
Colorado	823,511	825,163	826,815	829,437	831,821	834,212	836,630	838,820	841,192	843,581	845,762

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:						
	11/27	11/28	11/29	11/30	12/1	12/2	12/3	12/4	12/5	12/6	12/7
Adams	83,837	84,000	84,163	84,389	84,636	84,871	85,110	85,346	85,589	85,824	86,067
Arapahoe	88,408	88,603	88,799	89,086	89,364	89,652	89,920	90,193	90,470	90,753	91,034
Boulder	34,379	34,440	34,500	34,592	34,690	34,781	34,873	34,966	35,055	35,150	35,239
Denver	101,256	101,438	101,619	101,970	102,302	102,623	102,964	103,290	103,628	103,970	104,306
Douglas	45,309	45,387	45,465	45,645	45,802	45,959	46,115	46,268	46,427	46,584	46,738
Eagle	9,211	9,224	9,238	9,262	9,280	9,298	9,315	9,332	9,349	9,366	9,382
El Paso	113,617	113,853	114,089	114,464	114,776	115,085	115,391	115,697	115,990	116,289	116,583
Gunnison	1,981	1,981	1,982	1,986	1,992	1,997	2,003	2,009	2,015	2,020	2,026
Jefferson	72,262	72,461	72,659	72,952	73,232	73,517	73,794	74,078	74,361	74,647	74,933
Larimer	44,733	44,817	44,901	45,018	45,145	45,263	45,386	45,504	45,618	45,731	45,847
Pueblo	29,284	29,333	29,383	29,441	29,515	29,588	29,659	29,728	29,796	29,864	29,930
Weld	52,398	52,504	52,611	52,778	52,925	53,071	53,217	53,355	53,499	53,637	53,778

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:		
	11/27	11/28	11/29	11/30	12/2	12/4	12/6
Adams	83,837	84,000	84,163	84,389	84,871 (16,974) [4,074] {2,037}	85,346 (17,069) [4,097] {2,048}	85,824 (17,165) [4,120] {2,060}
Arapahoe	88,408	88,603	88,799	89,086	89,652 (17,930) [4,303] {2,152}	90,193 (18,039) [4,329] {2,165}	90,753 (18,151) [4,356] {2,178}
Boulder	34,379	34,440	34,500	34,592	34,781 (6,956) [1,670] {835}	34,966 (6,993) [1,678] {839}	35,150 (7,030) [1,687] {844}
Denver	101,256	101,438	101,619	101,970	102,623 (20,525) [4,926] {2,463}	103,290 (20,658) [4,958] {2,479}	103,970 (20,794) [4,991] {2,495}
Douglas	45,309	45,387	45,465	45,645	45,959 (9,192) [2,206] {1,103}	46,268 (9,254) [2,221] {1,110}	46,584 (9,317) [2,236] {1,118}
Eagle	9,211	9,224	9,238	9,262	9,298 (1,860) [446] {223}	9,332 (1,866) [448] {224}	9,366 (1,873) [450] {225}
El Paso	113,617	113,853	114,089	114,464	115,085 (23,017) [5,524] {2,762}	115,697 (23,139) [5,553] {2,777}	116,289 (23,258) [5,582] {2,791}
Gunnison	1,981	1,981	1,982	1,986	1,997 (399) [96] {48}	2,009 (402) [96] {48}	2,020 (404) [97] {48}
Jefferson	72,262	72,461	72,659	72,952	73,517 (14,703) [3,529] {1,764}	74,078 (14,816) [3,556] {1,778}	74,647 (14,929) [3,583] {1,792}
Larimer	44,733	44,817	44,901	45,018	45,263 (9,053) [2,173] {1,086}	45,504 (9,101) [2,184] {1,092}	45,731 (9,146) [2,195] {1,098}
Pueblo	29,284	29,333	29,383	29,441	29,588 (5,918) [1,420] {710}	29,728 (5,946) [1,427] {713}	29,864 (5,973) [1,433] {717}
Weld	52,398	52,504	52,611	52,778	53,071 (10,614) [2,547] {1,274}	53,355 (10,671) [2,561] {1,281}	53,637 (10,727) [2,575] {1,287}

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.