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

Date: 12/10/21

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 12/10/21 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.

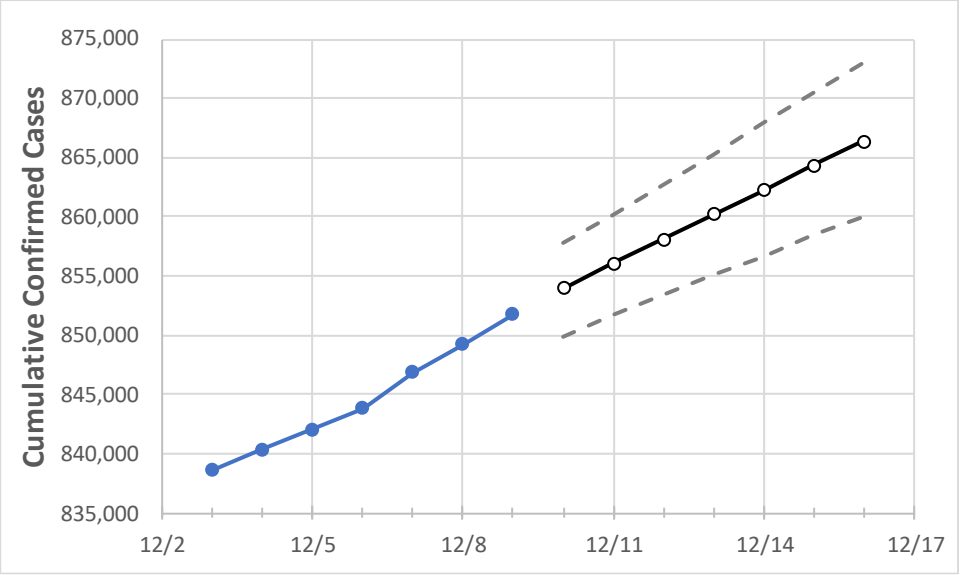
IEM's Modeling Lead

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:						
	12/6	12/7	12/8	12/9	12/10	12/11	12/12	12/13	12/14	12/15	12/16
Colorado	843,851	846,892	849,269	851,785	853,945	856,040	858,089	860,175	862,249	864,371	866,397

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:						
	12/6	12/7	12/8	12/9	12/10	12/11	12/12	12/13	12/14	12/15	12/16
Adams	85,789	86,118	86,334	86,572	86,779	86,988	87,187	87,391	87,599	87,800	87,996
Arapahoe	90,722	91,030	91,262	91,507	91,753	91,995	92,231	92,468	92,705	92,948	93,183
Boulder	35,196	35,303	35,386	35,497	35,583	35,669	35,756	35,846	35,929	36,014	36,098
Denver	103,523	103,842	104,065	104,299	104,533	104,761	104,988	105,222	105,443	105,674	105,890
Douglas	46,453	46,630	46,747	46,891	47,012	47,127	47,245	47,355	47,472	47,591	47,701
Eagle	9,354	9,351	9,367	9,387	9,400	9,414	9,427	9,440	9,453	9,466	9,478
El Paso	116,459	116,876	117,219	117,551	117,834	118,120	118,403	118,694	118,982	119,255	119,545
Gunnison	2,028	2,032	2,039	2,046	2,051	2,056	2,061	2,066	2,071	2,076	2,081
Jefferson	74,184	74,512	74,697	74,961	75,160	75,364	75,564	75,765	75,959	76,156	76,343
Larimer	45,890	46,055	46,211	46,359	46,481	46,598	46,711	46,829	46,946	47,067	47,178
Pueblo	29,969	30,071	30,160	30,254	30,323	30,388	30,453	30,514	30,582	30,647	30,708
Weld	53,728	53,998	54,194	54,313	54,453	54,605	54,745	54,888	55,030	55,178	55,316

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:		
	12/6	12/7	12/8	12/9	12/11	12/13	12/15
Adams	85,789	86,118	86,334	86,572	86,988 (17,398) [4,175] {2,088}	87,391 (17,478) [4,195] {2,097}	87,800 (17,560) [4,214] {2,107}
Arapahoe	90,722	91,030	91,262	91,507	91,995 (18,399) [4,416] {2,208}	92,468 (18,494) [4,438] {2,219}	92,948 (18,590) [4,462] {2,231}
Boulder	35,196	35,303	35,386	35,497	35,669 (7,134) [1,712] {856}	35,846 (7,169) [1,721] {860}	36,014 (7,203) [1,729] {864}
Denver	103,523	103,842	104,065	104,299	104,761 (20,952) [5,029] {2,514}	105,222 (21,044) [5,051] {2,525}	105,674 (21,135) [5,072] {2,536}
Douglas	46,453	46,630	46,747	46,891	47,127 (9,425) [2,262] {1,131}	47,355 (9,471) [2,273] {1,137}	47,591 (9,518) [2,284] {1,142}
Eagle	9,354	9,351	9,367	9,387	9,414 (1,883) [452] {226}	9,440 (1,888) [453] {227}	9,466 (1,893) [454] {227}
El Paso	116,459	116,876	117,219	117,551	118,120 (23,624) [5,670] {2,835}	118,694 (23,739) [5,697] {2,849}	119,255 (23,851) [5,724] {2,862}
Gunnison	2,028	2,032	2,039	2,046	2,056 (411) [99] {49}	2,066 (413) [99] {50}	2,076 (415) [100] {50}
Jefferson	74,184	74,512	74,697	74,961	75,364 (15,073) [3,617] {1,809}	75,765 (15,153) [3,637] {1,818}	76,156 (15,231) [3,655] {1,828}
Larimer	45,890	46,055	46,211	46,359	46,598 (9,320) [2,237] {1,118}	46,829 (9,366) [2,248] {1,124}	47,067 (9,413) [2,259] {1,130}
Pueblo	29,969	30,071	30,160	30,254	30,388 (6,078) [1,459] {729}	30,514 (6,103) [1,465] {732}	30,647 (6,129) [1,471] {736}
Weld	53,728	53,998	54,194	54,313	54,605 (10,921) [2,621] {1,311}	54,888 (10,978) [2,635] {1,317}	55,178 (11,036) [2,649] {1,324}

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.