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

Date: 11/15/21

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 11/15/21 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.

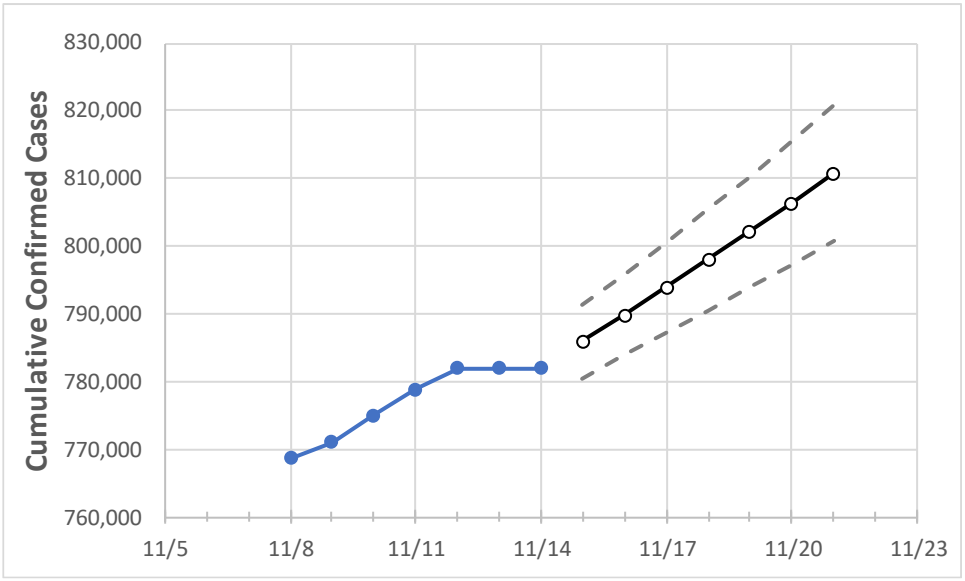
IEM's Modeling Lead

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:						
	11/11	11/12	11/13	11/14	11/15	11/16	11/17	11/18	11/19	11/20	11/21
Colorado	778,909	781,960	781,960	781,960	785,907	789,827	793,874	798,015	802,143	806,380	810,749

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:						
	11/11	11/12	11/13	11/14	11/15	11/16	11/17	11/18	11/19	11/20	11/21
Adams	79,574	79,874	79,874	79,874	80,168	80,479	80,791	81,112	81,426	81,751	82,084
Arapahoe	83,754	84,020	84,020	84,020	84,339	84,662	84,991	85,315	85,653	85,994	86,344
Boulder	32,624	32,761	32,761	32,761	32,914	33,069	33,230	33,392	33,555	33,726	33,901
Denver	96,074	96,348	96,348	96,348	96,685	97,018	97,359	97,701	98,051	98,408	98,768
Douglas	42,741	42,896	42,896	42,896	43,070	43,243	43,418	43,596	43,774	43,959	44,143
Eagle	8,840	8,863	8,863	8,863	8,908	8,954	9,000	9,050	9,100	9,153	9,207
El Paso	107,863	108,268	108,268	108,268	108,714	109,168	109,625	110,083	110,552	111,018	111,497
Gunnison	1,891	1,895	1,895	1,895	1,901	1,907	1,913	1,919	1,925	1,933	1,939
Jefferson	67,533	67,787	67,787	67,787	68,085	68,380	68,684	68,991	69,298	69,617	69,924
Larimer	42,257	42,489	42,489	42,489	42,700	42,920	43,129	43,343	43,561	43,783	44,011
Pueblo	27,607	27,743	27,743	27,743	27,901	28,055	28,208	28,365	28,526	28,684	28,849
Weld	49,701	49,901	49,901	49,901	50,107	50,317	50,528	50,734	50,945	51,154	51,368

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:		
	11/11	11/12	11/13	11/14	11/16	11/18	11/20
Adams	79,574	79,874	79,874	79,874	80,479 (16,096) [3,863] {1,932}	81,112 (16,222) [3,893] {1,947}	81,751 (16,350) [3,924] {1,962}
Arapahoe	83,754	84,020	84,020	84,020	84,662 (16,932) [4,064] {2,032}	85,315 (17,063) [4,095] {2,048}	85,994 (17,199) [4,128] {2,064}
Boulder	32,624	32,761	32,761	32,761	33,069 (6,614) [1,587] {794}	33,392 (6,678) [1,603] {801}	33,726 (6,745) [1,619] {809}
Denver	96,074	96,348	96,348	96,348	97,018 (19,404) [4,657] {2,328}	97,701 (19,540) [4,690] {2,345}	98,408 (19,682) [4,724] {2,362}
Douglas	42,741	42,896	42,896	42,896	43,243 (8,649) [2,076] {1,038}	43,596 (8,719) [2,093] {1,046}	43,959 (8,792) [2,110] {1,055}
Eagle	8,840	8,863	8,863	8,863	8,954 (1,791) [430] {215}	9,050 (1,810) [434] {217}	9,153 (1,831) [439] {220}
El Paso	107,863	108,268	108,268	108,268	109,168 (21,834) [5,240] {2,620}	110,083 (22,017) [5,284] {2,642}	111,018 (22,204) [5,329] {2,664}
Gunnison	1,891	1,895	1,895	1,895	1,907 (381) [92] {46}	1,919 (384) [92] {46}	1,933 (387) [93] {46}
Jefferson	67,533	67,787	67,787	67,787	68,380 (13,676) [3,282] {1,641}	68,991 (13,798) [3,312] {1,656}	69,617 (13,923) [3,342] {1,671}
Larimer	42,257	42,489	42,489	42,489	42,920 (8,584) [2,060] {1,030}	43,343 (8,669) [2,080] {1,040}	43,783 (8,757) [2,102] {1,051}
Pueblo	27,607	27,743	27,743	27,743	28,055 (5,611) [1,347] {673}	28,365 (5,673) [1,362] {681}	28,684 (5,737) [1,377] {688}
Weld	49,701	49,901	49,901	49,901	50,317 (10,063) [2,415] {1,208}	50,734 (10,147) [2,435] {1,218}	51,154 (10,231) [2,455] {1,228}

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.