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

Date: 1/26/21

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 1/26/21 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.

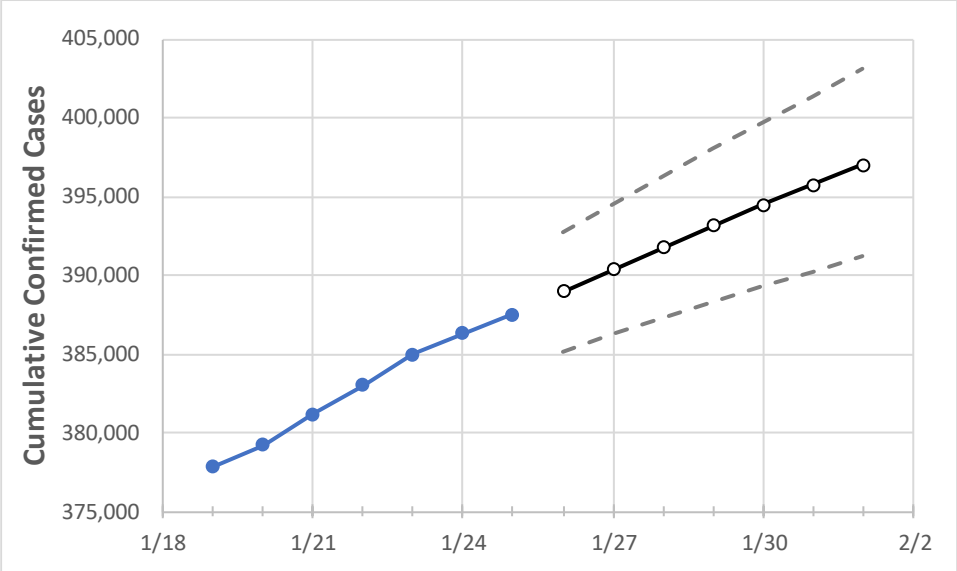
IEM's Modeling Lead

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:						
	1/22	1/23	1/24	1/25	1/26	1/27	1/28	1/29	1/30	1/31	2/1
Colorado	383,008	384,966	386,285	387,500	388,953	390,357	391,767	393,129	394,446	395,762	397,007

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:						
	1/22	1/23	1/24	1/25	1/26	1/27	1/28	1/29	1/30	1/31	2/1
Adams	44,580	44,752	44,877	44,990	45,109	45,223	45,332	45,442	45,548	45,649	45,749
Arapahoe	43,498	43,735	43,906	44,054	44,224	44,388	44,547	44,702	44,854	45,000	45,141
Boulder	16,595	16,683	16,742	16,788	16,850	16,910	16,969	17,026	17,082	17,137	17,191
Denver	54,162	54,371	54,528	54,706	54,872	55,032	55,193	55,347	55,498	55,646	55,791
Douglas	18,187	18,297	18,374	18,426	18,505	18,582	18,658	18,730	18,801	18,870	18,940
Eagle	4,147	4,172	4,192	4,220	4,258	4,294	4,331	4,369	4,406	4,444	4,484
El Paso	46,518	46,680	46,818	46,914	47,060	47,198	47,330	47,456	47,579	47,704	47,825
Gunnison	962	975	987	994	1,010	1,027	1,045	1,063	1,081	1,100	1,119
Jefferson	33,489	33,640	33,760	33,877	33,999	34,118	34,233	34,345	34,456	34,566	34,675
Larimer	17,331	17,454	17,517	17,578	17,665	17,750	17,834	17,918	17,998	18,079	18,160
Pueblo	14,131	14,159	14,177	14,190	14,208	14,224	14,241	14,256	14,270	14,284	14,298
Weld	22,948	23,033	23,106	23,179	23,267	23,351	23,436	23,520	23,598	23,672	23,747

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:		
	1/22	1/23	1/24	1/25	1/27	1/29	1/31
Adams	44,580	44,752	44,877	44,990	45,223 (9,045) [2,171] {1,085}	45,442 (9,088) [2,181] {1,091}	45,649 (9,130) [2,191] {1,096}
Arapahoe	43,498	43,735	43,906	44,054	44,388 (8,878) [2,131] {1,065}	44,702 (8,940) [2,146] {1,073}	45,000 (9,000) [2,160] {1,080}
Boulder	16,595	16,683	16,742	16,788	16,910 (3,382) [812] {406}	17,026 (3,405) [817] {409}	17,137 (3,427) [823] {411}
Denver	54,162	54,371	54,528	54,706	55,032 (11,006) [2,642] {1,321}	55,347 (11,069) [2,657] {1,328}	55,646 (11,129) [2,671] {1,335}
Douglas	18,187	18,297	18,374	18,426	18,582 (3,716) [892] {446}	18,730 (3,746) [899] {450}	18,870 (3,774) [906] {453}
Eagle	4,147	4,172	4,192	4,220	4,294 (859) [206] {103}	4,369 (874) [210] {105}	4,444 (889) [213] {107}
El Paso	46,518	46,680	46,818	46,914	47,198 (9,440) [2,266] {1,133}	47,456 (9,491) [2,278] {1,139}	47,704 (9,541) [2,290] {1,145}
Gunnison	962	975	987	994	1,027 (205) [49] {25}	1,063 (213) [51] {26}	1,100 (220) [53] {26}
Jefferson	33,489	33,640	33,760	33,877	34,118 (6,824) [1,638] {819}	34,345 (6,869) [1,649] {824}	34,566 (6,913) [1,659] {830}
Larimer	17,331	17,454	17,517	17,578	17,750 (3,550) [852] {426}	17,918 (3,584) [860] {430}	18,079 (3,616) [868] {434}
Pueblo	14,131	14,159	14,177	14,190	14,224 (2,845) [683] {341}	14,256 (2,851) [684] {342}	14,284 (2,857) [686] {343}
Weld	22,948	23,033	23,106	23,179	23,351 (4,670) [1,121] {560}	23,520 (4,704) [1,129] {564}	23,672 (4,734) [1,136] {568}

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.