IEM's AI Modeling: Short-term COVID-19 Projections
Date: 12/7/20

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 <u>not</u> 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 12/7/20 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
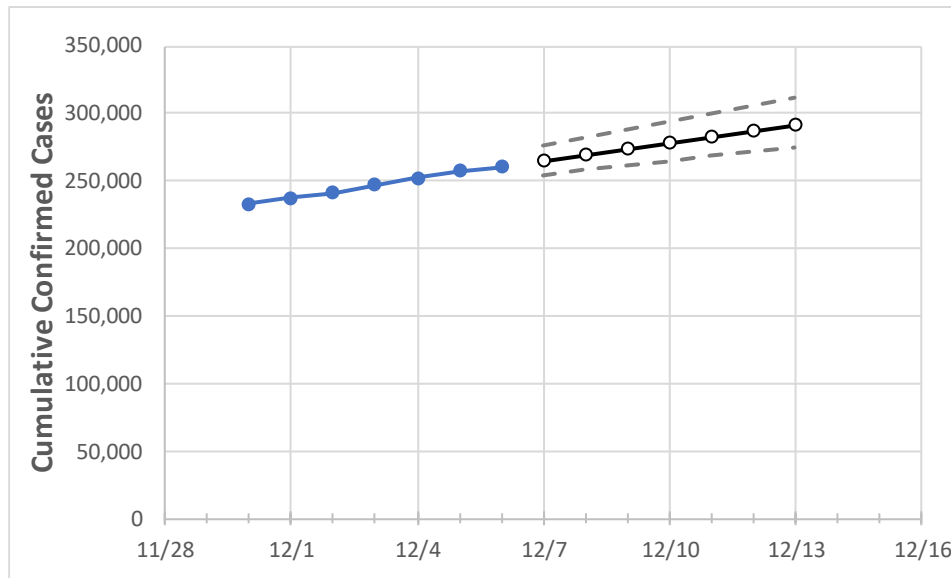
	Actual Confirmed Cases On:				Projected Cases For:						
	12/3	12/4	12/5	12/6	12/7	12/8	12/9	12/10	12/11	12/12	12/13
Colorado	247,209	252,222	257,347	260,581	264,992	269,402	273,810	278,217	282,621	287,025	291,426

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 20%, and are often within 10%, of actual confirmed cases.

Colorado Counties

	Actual Confirmed Cases On:				Projected Cases For:						
	12/3	12/4	12/5	12/6	12/7	12/8	12/9	12/10	12/11	12/12	12/13
Adams	31,038	31,535	32,044	32,334	32,742	33,147	33,548	33,945	34,339	34,729	35,116
Arapahoe	28,683	29,191	29,769	30,170	30,618	31,065	31,512	31,959	32,404	32,849	33,293
Boulder	11,626	11,775	11,949	12,043	12,184	12,324	12,462	12,599	12,735	12,869	13,002
Denver	38,219	38,770	39,327	39,770	40,233	40,690	41,143	41,590	42,032	42,469	42,902
Douglas	11,456	11,714	11,970	12,167	12,391	12,615	12,839	13,063	13,287	13,512	13,736
Eagle	2,477	2,498	2,536	2,572	2,605	2,638	2,671	2,706	2,740	2,775	2,811
El Paso	29,420	30,174	30,761	31,181	31,826	32,476	33,132	33,794	34,462	35,135	35,814
Gunnison	491	493	495	502	505	509	512	515	519	522	526
Jefferson	21,922	22,352	22,830	23,132	23,506	23,880	24,251	24,622	24,991	25,359	25,726
Larimer	10,932	11,164	11,519	11,664	11,875	12,087	12,299	12,512	12,726	12,940	13,155
Pueblo	9,335	9,540	9,749	9,884	10,108	10,332	10,556	10,780	11,003	11,226	11,448
Weld	14,850	15,145	15,486	15,679	15,937	16,195	16,452	16,710	16,967	17,224	17,480

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:		
	12/3	12/4	12/5	12/6	12/8	12/10	12/12
Adams	31,038	31,535	32,044	32,334	33,147 (6,629) [1,591] {796}	33,945 (6,789) [1,629] {815}	34,729 (6,946) [1,667] {834}
Arapahoe	28,683	29,191	29,769	30,170	31,065 (6,213) [1,491] {746}	31,959 (6,392) [1,534] {767}	32,849 (6,570) [1,577] {788}
Boulder	11,626	11,775	11,949	12,043	12,324 (2,465) [592] {296}	12,599 (2,520) [605] {302}	12,869 (2,574) [618] {309}
Denver	38,219	38,770	39,327	39,770	40,690 (8,138) [1,953] {977}	41,590 (8,318) [1,996] {998}	42,469 (8,494) [2,039] {1,019}
Douglas	11,456	11,714	11,970	12,167	12,615 (2,523) [606] {303}	13,063 (2,613) [627] {314}	13,512 (2,702) [649] {324}
Eagle	2,477	2,498	2,536	2,572	2,638 (528) [127] {63}	2,706 (541) [130] {65}	2,775 (555) [133] {67}
El Paso	29,420	30,174	30,761	31,181	32,476 (6,495) [1,559] {779}	33,794 (6,759) [1,622] {811}	35,135 (7,027) [1,686] {843}
Gunnison	491	493	495	502	509 (102) [24] {12}	515 (103) [25] {12}	522 (104) [25] {13}
Jefferson	21,922	22,352	22,830	23,132	23,880 (4,776) [1,146] {573}	24,622 (4,924) [1,182] {591}	25,359 (5,072) [1,217] {609}
Larimer	10,932	11,164	11,519	11,664	12,087 (2,417) [580] {290}	12,512 (2,502) [601] {300}	12,940 (2,588) [621] {311}
Pueblo	9,335	9,540	9,749	9,884	10,332 (2,066) [496] {248}	10,780 (2,156) [517] {259}	11,226 (2,245) [539] {269}
Weld	14,850	15,145	15,486	15,679	16,195 (3,239) [777] {389}	16,710 (3,342) [802] {401}	17,224 (3,445) [827] {413}

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.