IEM's AI Modeling: Short-term COVID-19 Projections
Date: 12/1/20

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 12/1/20 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
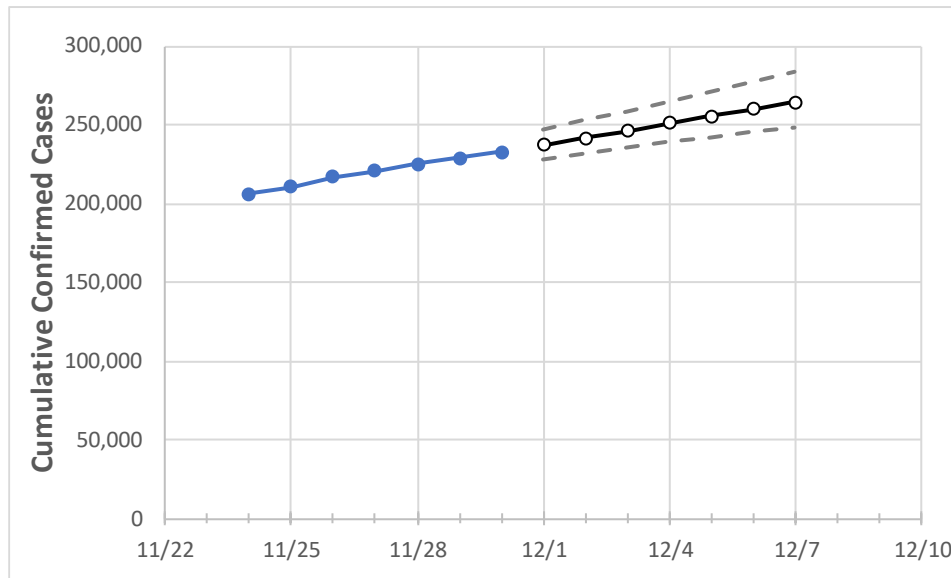
	Actual Confirmed Cases On:				Projected Cases For:						
	11/27	11/28	11/29	11/30	12/1	12/2	12/3	12/4	12/5	12/6	12/7
Colorado	220,953	225,283	228,772	232,905	237,386	241,862	246,332	250,797	255,257	259,712	264,160

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:						
	11/27	11/28	11/29	11/30	12/1	12/2	12/3	12/4	12/5	12/6	12/7
Adams	28,347	28,784	29,130	29,665	30,106	30,543	30,976	31,406	31,832	32,255	32,675
Arapahoe	25,936	26,391	26,753	27,228	27,668	28,105	28,539	28,969	29,397	29,821	30,242
Boulder	10,669	10,793	10,926	11,111	11,265	11,417	11,568	11,717	11,865	12,011	12,155
Denver	35,490	35,906	36,243	36,704	37,226	37,742	38,252	38,756	39,254	39,746	40,233
Douglas	10,183	10,404	10,560	10,782	11,018	11,255	11,492	11,729	11,967	12,205	12,444
Eagle	2,272	2,338	2,364	2,390	2,424	2,459	2,494	2,530	2,567	2,604	2,642
El Paso	25,425	26,026	26,639	27,197	27,823	28,453	29,088	29,728	30,372	31,021	31,675
Gunnison	461	466	471	473	475	478	480	483	486	488	491
Jefferson	19,704	20,106	20,358	20,710	21,091	21,471	21,848	22,224	22,598	22,970	23,341
Larimer	9,726	9,946	10,115	10,253	10,449	10,643	10,835	11,024	11,212	11,397	11,581
Pueblo	7,860	8,077	8,269	8,594	8,858	9,125	9,395	9,669	9,945	10,225	10,508
Weld	13,353	13,620	13,813	14,026	14,272	14,514	14,753	14,989	15,221	15,451	15,677

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	28,347	28,784	29,130	29,665	30,543 (6,109) [1,466] {733}	31,406 (6,281) [1,507] {754}	32,255 (6,451) [1,548] {774}
Arapahoe	25,936	26,391	26,753	27,228	28,105 (5,621) [1,349] {675}	28,969 (5,794) [1,391] {695}	29,821 (5,964) [1,431] {716}
Boulder	10,669	10,793	10,926	11,111	11,417 (2,283) [548] {274}	11,717 (2,343) [562] {281}	12,011 (2,402) [577] {288}
Denver	35,490	35,906	36,243	36,704	37,742 (7,548) [1,812] {906}	38,756 (7,751) [1,860] {930}	39,746 (7,949) [1,908] {954}
Douglas	10,183	10,404	10,560	10,782	11,255 (2,251) [540] {270}	11,729 (2,346) [563] {281}	12,205 (2,441) [586] {293}
Eagle	2,272	2,338	2,364	2,390	2,459 (492) [118] {59}	2,530 (506) [121] {61}	2,604 (521) [125] {62}
El Paso	25,425	26,026	26,639	27,197	28,453 (5,691) [1,366] {683}	29,728 (5,946) [1,427] {713}	31,021 (6,204) [1,489] {745}
Gunnison	461	466	471	473	478 (96) [23] {11}	483 (97) [23] {12}	488 (98) [23] {12}
Jefferson	19,704	20,106	20,358	20,710	21,471 (4,294) [1,031] {515}	22,224 (4,445) [1,067] {533}	22,970 (4,594) [1,103] {551}
Larimer	9,726	9,946	10,115	10,253	10,643 (2,129) [511] {255}	11,024 (2,205) [529] {265}	11,397 (2,279) [547] {274}
Pueblo	7,860	8,077	8,269	8,594	9,125 (1,825) [438] {219}	9,669 (1,934) [464] {232}	10,225 (2,045) [491] {245}
Weld	13,353	13,620	13,813	14,026	14,514 (2,903) [697] {348}	14,989 (2,998) [719] {360}	15,451 (3,090) [742] {371}

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.