IEM's AI Modeling: Short-term COVID-19 Projections
Date: 12/17/20

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 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 12/17/20 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
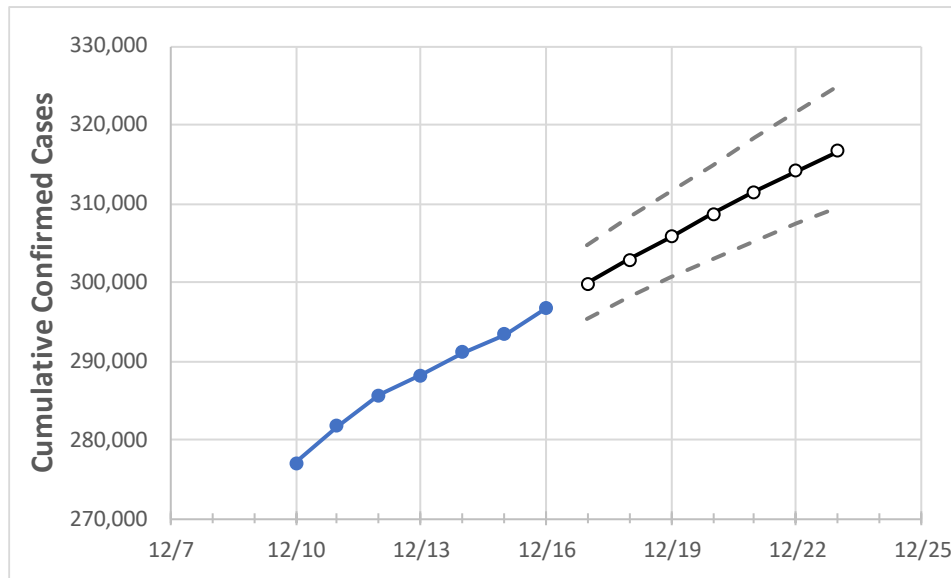
	Actual Confirmed Cases On:				Projected Cases For:						
	12/13	12/14	12/15	12/16	12/17	12/18	12/19	12/20	12/21	12/22	12/23
Colorado	288,193	291,104	293,382	296,716	299,847	302,880	305,820	308,671	311,436	314,117	316,717

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:						
	12/13	12/14	12/15	12/16	12/17	12/18	12/19	12/20	12/21	12/22	12/23
Adams	35,145	35,483	35,725	36,030	36,368	36,699	37,024	37,342	37,655	37,961	38,261
Arapahoe	32,946	33,292	33,538	33,883	34,242	34,595	34,941	35,282	35,616	35,945	36,268
Boulder	12,948	13,057	13,139	13,266	13,376	13,483	13,588	13,691	13,791	13,889	13,985
Denver	42,578	42,850	43,034	43,344	43,669	43,986	44,294	44,593	44,885	45,168	45,444
Douglas	13,504	13,620	13,752	13,871	14,023	14,171	14,315	14,454	14,590	14,721	14,849
Eagle	2,851	2,904	2,938	2,961	2,999	3,037	3,075	3,113	3,151	3,190	3,229
El Paso	35,123	35,496	35,784	36,323	36,836	37,342	37,840	38,331	38,815	39,291	39,760
Gunnison	542	545	554	561	567	573	580	586	593	600	606
Jefferson	25,748	25,931	26,117	26,471	26,766	27,053	27,334	27,609	27,877	28,139	28,395
Larimer	13,069	13,158	13,273	13,465	13,642	13,816	13,987	14,156	14,322	14,486	14,647
Pueblo	11,415	11,615	11,705	11,869	12,047	12,222	12,395	12,564	12,731	12,895	13,056
Weld	17,240	17,432	17,566	17,723	17,913	18,098	18,280	18,457	18,630	18,799	18,965

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:		
	12/13	12/14	12/15	12/16	12/18	12/20	12/22
Adams	35,145	35,483	35,725	36,030	36,699 (7,340) [1,762] {881}	37,342 (7,468) [1,792] {896}	37,961 (7,592) [1,822] {911}
Arapahoe	32,946	33,292	33,538	33,883	34,595 (6,919) [1,661] {830}	35,282 (7,056) [1,694] {847}	35,945 (7,189) [1,725] {863}
Boulder	12,948	13,057	13,139	13,266	13,483 (2,697) [647] {324}	13,691 (2,738) [657] {329}	13,889 (2,778) [667] {333}
Denver	42,578	42,850	43,034	43,344	43,986 (8,797) [2,111] {1,056}	44,593 (8,919) [2,140] {1,070}	45,168 (9,034) [2,168] {1,084}
Douglas	13,504	13,620	13,752	13,871	14,171 (2,834) [680] {340}	14,454 (2,891) [694] {347}	14,721 (2,944) [707] {353}
Eagle	2,851	2,904	2,938	2,961	3,037 (607) [146] {73}	3,113 (623) [149] {75}	3,190 (638) [153] {77}
El Paso	35,123	35,496	35,784	36,323	37,342 (7,468) [1,792] {896}	38,331 (7,666) [1,840] {920}	39,291 (7,858) [1,886] {943}
Gunnison	542	545	554	561	573 (115) [28] {14}	586 (117) [28] {14}	600 (120) [29] {14}
Jefferson	25,748	25,931	26,117	26,471	27,053 (5,411) [1,299] {649}	27,609 (5,522) [1,325] {663}	28,139 (5,628) [1,351] {675}
Larimer	13,069	13,158	13,273	13,465	13,816 (2,763) [663] {332}	14,156 (2,831) [679] {340}	14,486 (2,897) [695] {348}
Pueblo	11,415	11,615	11,705	11,869	12,222 (2,444) [587] {293}	12,564 (2,513) [603] {302}	12,895 (2,579) [619] {309}
Weld	17,240	17,432	17,566	17,723	18,098 (3,620) [869] {434}	18,457 (3,691) [886] {443}	18,799 (3,760) [902] {451}

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.