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

Date: 12/18/20

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 12/18/20 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.

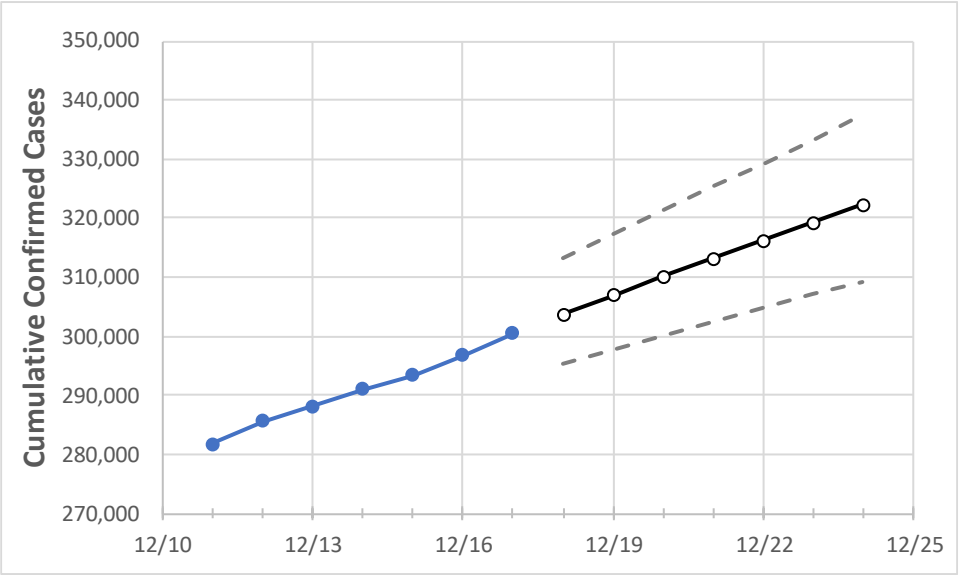
IEM's Modeling Lead

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:						
	12/14	12/15	12/16	12/17	12/18	12/19	12/20	12/21	12/22	12/23	12/24
Colorado	291,104	293,382	296,716	300,414	303,703	306,932	310,101	313,214	316,269	319,269	322,215

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:						
	12/14	12/15	12/16	12/17	12/18	12/19	12/20	12/21	12/22	12/23	12/24
Adams	35,483	35,725	36,030	36,396	36,728	37,054	37,374	37,687	37,995	38,297	38,593
Arapahoe	33,292	33,538	33,883	34,227	34,556	34,877	35,190	35,496	35,794	36,085	36,369
Boulder	13,057	13,139	13,266	13,360	13,465	13,567	13,668	13,766	13,861	13,955	14,046
Denver	42,850	43,034	43,344	43,765	44,082	44,392	44,694	44,988	45,276	45,556	45,829
Douglas	13,620	13,752	13,871	14,035	14,181	14,322	14,459	14,592	14,721	14,846	14,968
Eagle	2,904	2,938	2,961	2,982	3,017	3,052	3,088	3,123	3,158	3,193	3,229
El Paso	35,496	35,784	36,323	36,752	37,245	37,732	38,213	38,687	39,155	39,616	40,072
Gunnison	545	554	561	569	575	582	589	596	603	610	618
Jefferson	25,931	26,117	26,471	26,831	27,126	27,415	27,698	27,976	28,247	28,513	28,774
Larimer	13,158	13,273	13,465	13,639	13,809	13,976	14,140	14,302	14,461	14,617	14,771
Pueblo	11,615	11,705	11,869	11,990	12,154	12,316	12,475	12,630	12,783	12,933	13,081
Weld	17,432	17,566	17,723	17,946	18,134	18,318	18,498	18,675	18,848	19,018	19,185

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:		
	12/14	12/15	12/16	12/17	12/19	12/21	12/23
Adams	35,483	35,725	36,030	36,396	37,054 (7,411) [1,779] {889}	37,687 (7,537) [1,809] {904}	38,297 (7,659) [1,838] {919}
Arapahoe	33,292	33,538	33,883	34,227	34,877 (6,975) [1,674] {837}	35,496 (7,099) [1,704] {852}	36,085 (7,217) [1,732] {866}
Boulder	13,057	13,139	13,266	13,360	13,567 (2,713) [651] {326}	13,766 (2,753) [661] {330}	13,955 (2,791) [670] {335}
Denver	42,850	43,034	43,344	43,765	44,392 (8,878) [2,131] {1,065}	44,988 (8,998) [2,159] {1,080}	45,556 (9,111) [2,187] {1,093}
Douglas	13,620	13,752	13,871	14,035	14,322 (2,864) [687] {344}	14,592 (2,918) [700] {350}	14,846 (2,969) [713] {356}
Eagle	2,904	2,938	2,961	2,982	3,052 (610) [147] {73}	3,123 (625) [150] {75}	3,193 (639) [153] {77}
El Paso	35,496	35,784	36,323	36,752	37,732 (7,546) [1,811] {906}	38,687 (7,737) [1,857] {928}	39,616 (7,923) [1,902] {951}
Gunnison	545	554	561	569	582 (116) [28] {14}	596 (119) [29] {14}	610 (122) [29] {15}
Jefferson	25,931	26,117	26,471	26,831	27,415 (5,483) [1,316] {658}	27,976 (5,595) [1,343] {671}	28,513 (5,703) [1,369] {684}
Larimer	13,158	13,273	13,465	13,639	13,976 (2,795) [671] {335}	14,302 (2,860) [686] {343}	14,617 (2,923) [702] {351}
Pueblo	11,615	11,705	11,869	11,990	12,316 (2,463) [591] {296}	12,630 (2,526) [606] {303}	12,933 (2,587) [621] {310}
Weld	17,432	17,566	17,723	17,946	18,318 (3,664) [879] {440}	18,675 (3,735) [896] {448}	19,018 (3,804) [913] {456}

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.