IEM's AI Modeling: Short-term COVID-19 Projections
Date: 12/3/20

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 12/3/20 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.

Tennessee State Projections
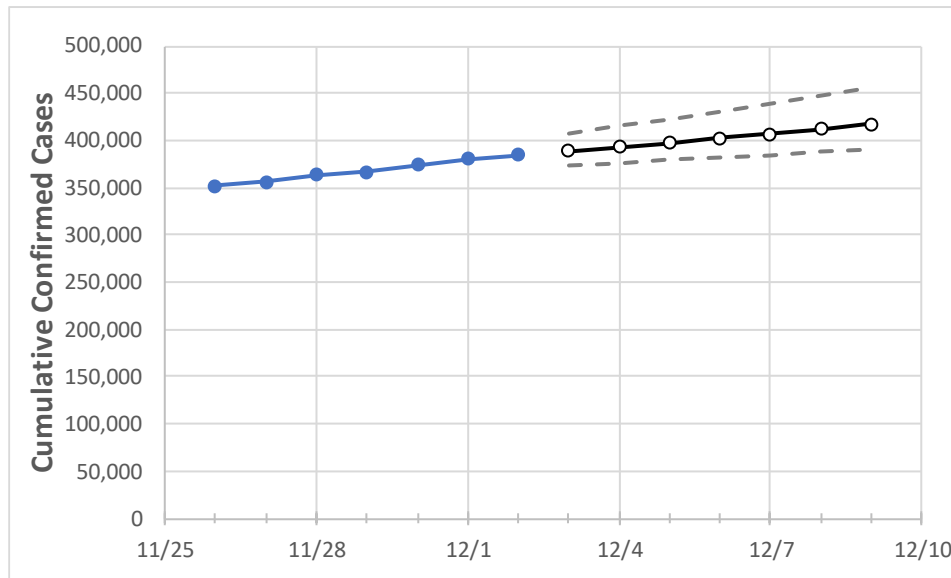
	Actual Confirmed Cases On:				Projected Cases For:						
	11/29	11/30	12/1	12/2	12/3	12/4	12/5	12/6	12/7	12/8	12/9
Tennessee	366,518	374,493	380,186	384,285	388,698	393,198	397,787	402,466	407,237	412,099	417,055

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.

Tennessee Counties

	Actual Confirmed Cases On:				Projected Cases For:						
	11/29	11/30	12/1	12/2	12/3	12/4	12/5	12/6	12/7	12/8	12/9
Blount	5,531	5,752	5,863	5,986	6,084	6,185	6,289	6,396	6,506	6,619	6,735
Davidson	42,880	43,546	43,915	44,374	44,666	44,960	45,255	45,552	45,851	46,151	46,453
Hamilton	16,861	17,311	17,549	17,857	18,070	18,288	18,510	18,738	18,971	19,209	19,453
Knox	18,930	19,358	19,739	19,960	20,209	20,463	20,723	20,989	21,261	21,538	21,822
Rutherford	17,930	18,248	18,613	18,788	18,969	19,152	19,336	19,522	19,709	19,897	20,088
Shelby	47,963	48,561	49,077	49,412	49,826	50,251	50,685	51,129	51,584	52,050	52,526
Sumner	9,817	10,123	10,255	10,404	10,531	10,659	10,788	10,918	11,049	11,181	11,314
Williamson	11,490	11,680	11,837	11,951	12,075	12,199	12,325	12,451	12,577	12,705	12,833

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.*

Tennessee Medical Demands by County

	Actual Confirmed Cases On:				Projected Cases (Hospitalized) [ICU] {Ventilator} For:		
	11/29	11/30	12/1	12/2	12/4	12/6	12/8
Blount	5,531	5,752	5,863	5,986	6,185 (1,237) [297] {148}	6,396 (1,279) [307] {154}	6,619 (1,324) [318] {159}
Davidson	42,880	43,546	43,915	44,374	44,960 (8,992) [2,158] {1,079}	45,552 (9,110) [2,186] {1,093}	46,151 (9,230) [2,215] {1,108}
Hamilton	16,861	17,311	17,549	17,857	18,288 (3,658) [878] {439}	18,738 (3,748) [899] {450}	19,209 (3,842) [922] {461}
Knox	18,930	19,358	19,739	19,960	20,463 (4,093) [982] {491}	20,989 (4,198) [1,007] {504}	21,538 (4,308) [1,034] {517}
Rutherford	17,930	18,248	18,613	18,788	19,152 (3,830) [919] {460}	19,522 (3,904) [937] {469}	19,897 (3,979) [955] {478}
Shelby	47,963	48,561	49,077	49,412	50,251 (10,050) [2,412] {1,206}	51,129 (10,226) [2,454] {1,227}	52,050 (10,410) [2,498] {1,249}
Sumner	9,817	10,123	10,255	10,404	10,659 (2,132) [512] {256}	10,918 (2,184) [524] {262}	11,181 (2,236) [537] {268}
Williamson	11,490	11,680	11,837	11,951	12,199 (2,440) [586] {293}	12,451 (2,490) [598] {299}	12,705 (2,541) [610] {305}

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.