IEM's AI Modeling: Short-term COVID-19 Projections
Date: 1/6/21

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 1/6/21 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
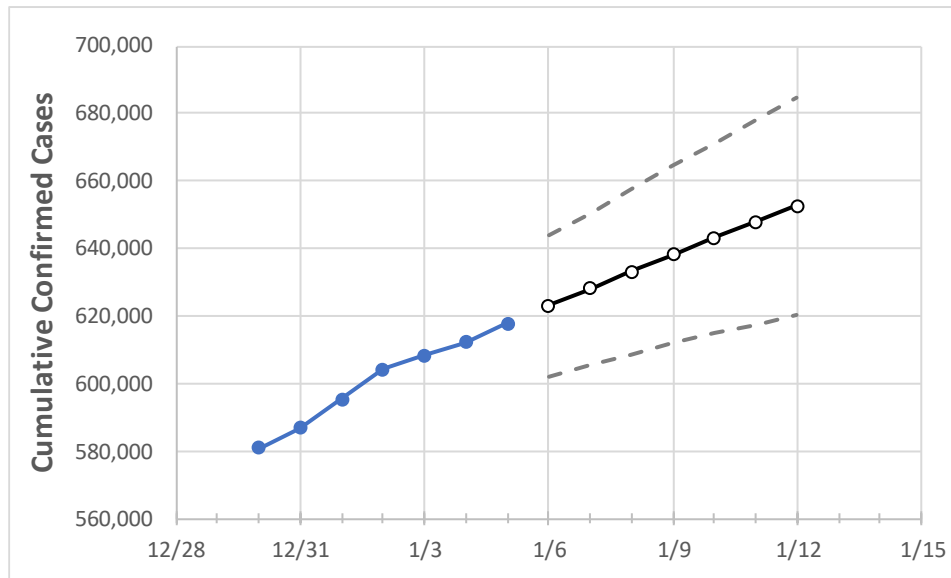
	Actual Confirmed Cases On:				Projected Cases For:						
	1/2	1/3	1/4	1/5	1/6	1/7	1/8	1/9	1/10	1/11	1/12
Tennessee	604,132	608,297	612,250	617,649	622,969	628,135	633,198	638,231	643,061	647,853	652,674

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 10%, and are often within 5%, of actual confirmed cases.

Tennessee Counties

	Actual Confirmed Cases On:				Projected Cases For:						
	1/2	1/3	1/4	1/5	1/6	1/7	1/8	1/9	1/10	1/11	1/12
Blount	10,324	10,379	10,433	10,494	10,606	10,717	10,826	10,934	11,043	11,152	11,259
Davidson	62,841	63,009	63,317	63,708	64,172	64,621	65,085	65,531	65,973	66,438	66,866
Hamilton	29,398	29,628	29,951	30,317	30,662	31,007	31,356	31,687	32,027	32,366	32,707
Knox	33,602	33,862	34,131	34,448	34,776	35,103	35,429	35,753	36,061	36,357	36,658
Rutherford	29,250	29,378	29,609	29,823	30,034	30,244	30,447	30,644	30,842	31,031	31,209
Shelby	68,426	68,753	69,131	69,666	70,184	70,700	71,201	71,702	72,220	72,718	73,217
Sumner	16,241	16,292	16,390	16,501	16,620	16,740	16,851	16,968	17,077	17,187	17,292
Williamson	18,533	18,641	18,829	19,037	19,251	19,470	19,688	19,894	20,106	20,322	20,533

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: | | |
	1/2	1/3	1/4	1/5	1/7	1/9	1/11
Blount	10,324	10,379	10,433	10,494	10,717 (2,143) [514] {257}	10,934 (2,187) [525] {262}	11,152 (2,230) [535] {268}
Davidson	62,841	63,009	63,317	63,708	64,621 (12,924) [3,102] {1,551}	65,531 (13,106) [3,145] {1,573}	66,438 (13,288) [3,189] {1,595}
Hamilton	29,398	29,628	29,951	30,317	31,007 (6,201) [1,488] {744}	31,687 (6,337) [1,521] {760}	32,366 (6,473) [1,554] {777}
Knox	33,602	33,862	34,131	34,448	35,103 (7,021) [1,685] {842}	35,753 (7,151) [1,716] {858}	36,357 (7,271) [1,745] {873}
Rutherford	29,250	29,378	29,609	29,823	30,244 (6,049) [1,452] {726}	30,644 (6,129) [1,471] {735}	31,031 (6,206) [1,489] {745}
Shelby	68,426	68,753	69,131	69,666	70,700 (14,140) [3,394] {1,697}	71,702 (14,340) [3,442] {1,721}	72,718 (14,544) [3,490] {1,745}
Sumner	16,241	16,292	16,390	16,501	16,740 (3,348) [804] {402}	16,968 (3,394) [814] {407}	17,187 (3,437) [825] {412}
Williamson	18,533	18,641	18,829	19,037	19,470 (3,894) [935] {467}	19,894 (3,979) [955] {477}	20,322 (4,064) [975] {488}

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.