IEM's AI Modeling: Short-term COVID-19 Projections
Date: 12/4/20

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 12/4/20 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
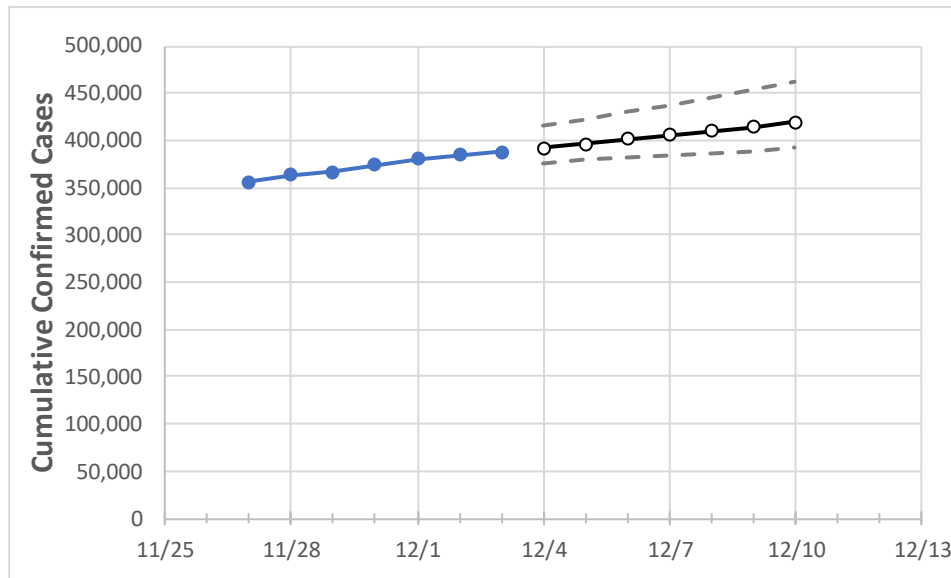
	Actual Confirmed Cases On:				Projected Cases For:						
	11/30	12/1	12/2	12/3	12/4	12/5	12/6	12/7	12/8	12/9	12/10
Tennessee	374,493	380,186	384,285	388,252	392,471	396,750	401,089	405,488	409,948	414,468	419,050

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:						
	11/30	12/1	12/2	12/3	12/4	12/5	12/6	12/7	12/8	12/9	12/10
Blount	5,752	5,863	5,986	6,089	6,186	6,286	6,388	6,493	6,600	6,710	6,824
Davidson	43,546	43,915	44,374	44,813	45,116	45,422	45,730	46,041	46,354	46,669	46,987
Hamilton	17,311	17,549	17,857	18,210	18,441	18,679	18,923	19,174	19,431	19,695	19,966
Knox	19,358	19,739	19,960	20,269	20,542	20,822	21,109	21,404	21,705	22,014	22,331
Rutherford	18,248	18,613	18,788	18,968	19,151	19,335	19,521	19,709	19,899	20,090	20,283
Shelby	48,561	49,077	49,412	49,731	50,130	50,536	50,950	51,371	51,798	52,234	52,676
Sumner	10,123	10,255	10,404	10,566	10,698	10,831	10,965	11,101	11,238	11,377	11,516
Williamson	11,680	11,837	11,951	12,090	12,219	12,349	12,479	12,611	12,743	12,876	13,009

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:		
	11/30	12/1	12/2	12/3	12/5	12/7	12/9
Blount	5,752	5,863	5,986	6,089	6,286 (1,257) [302] {151}	6,493 (1,299) [312] {156}	6,710 (1,342) [322] {161}
Davidson	43,546	43,915	44,374	44,813	45,422 (9,084) [2,180] {1,090}	46,041 (9,208) [2,210] {1,105}	46,669 (9,334) [2,240] {1,120}
Hamilton	17,311	17,549	17,857	18,210	18,679 (3,736) [897] {448}	19,174 (3,835) [920] {460}	19,695 (3,939) [945] {473}
Knox	19,358	19,739	19,960	20,269	20,822 (4,164) [999] {500}	21,404 (4,281) [1,027] {514}	22,014 (4,403) [1,057] {528}
Rutherford	18,248	18,613	18,788	18,968	19,335 (3,867) [928] {464}	19,709 (3,942) [946] {473}	20,090 (4,018) [964] {482}
Shelby	48,561	49,077	49,412	49,731	50,536 (10,107) [2,426] {1,213}	51,371 (10,274) [2,466] {1,233}	52,234 (10,447) [2,507] {1,254}
Sumner	10,123	10,255	10,404	10,566	10,831 (2,166) [520] {260}	11,101 (2,220) [533] {266}	11,377 (2,275) [546] {273}
Williamson	11,680	11,837	11,951	12,090	12,349 (2,470) [593] {296}	12,611 (2,522) [605] {303}	12,876 (2,575) [618] {309}

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.