IEM's AI Modeling: Short-term COVID-19 Projections
Date: 2/26/21

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 2/26/21 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
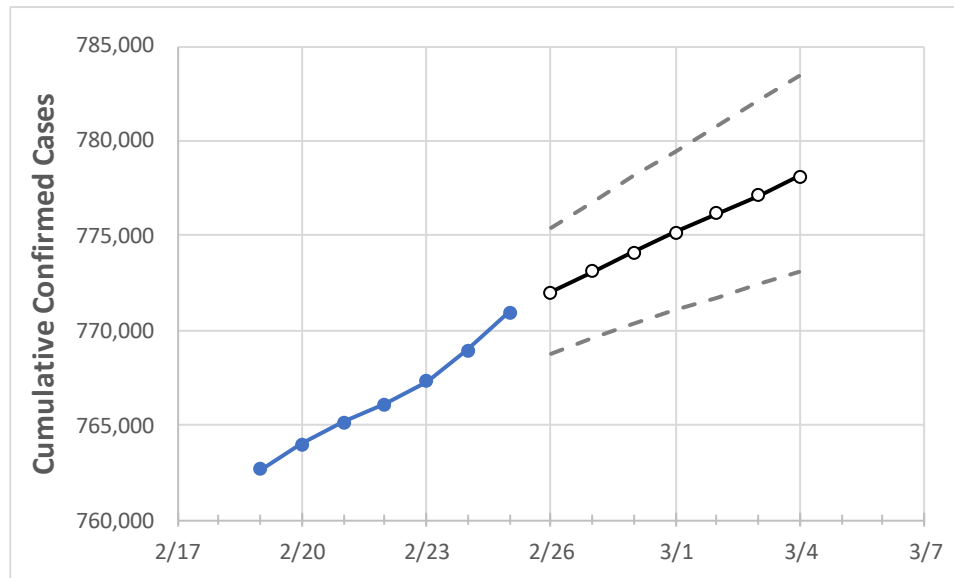
	Actual Confirmed Cases On:				Projected Cases For:						
	2/22	2/23	2/24	2/25	2/26	2/27	2/28	3/1	3/2	3/3	3/4
Tennessee	766,089	767,315	768,946	770,940	772,027	773,100	774,143	775,167	776,190	777,146	778,106

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:						
	2/22	2/23	2/24	2/25	2/26	2/27	2/28	3/1	3/2	3/3	3/4
Blount	13,880	13,905	13,929	13,959	13,983	14,007	14,029	14,051	14,072	14,092	14,111
Davidson	80,451	80,598	80,790	81,042	81,227	81,403	81,577	81,744	81,910	82,070	82,223
Hamilton	39,815	39,899	39,979	40,069	40,151	40,233	40,312	40,389	40,463	40,536	40,609
Knox	45,057	45,139	45,241	45,328	45,442	45,555	45,660	45,768	45,871	45,970	46,066
Rutherford	37,705	37,781	37,906	38,014	38,100	38,184	38,267	38,349	38,429	38,507	38,588
Shelby	86,235	86,383	86,600	86,794	86,952	87,104	87,255	87,401	87,548	87,685	87,817
Sumner	21,081	21,120	21,166	21,216	21,271	21,324	21,374	21,424	21,472	21,520	21,567
Williamson	24,880	24,944	25,011	25,081	25,131	25,181	25,230	25,277	25,323	25,367	25,408

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:		
	2/22	2/23	2/24	2/25	2/27	3/1	3/3
Blount	13,880	13,905	13,929	13,959	14,007 (2,801) [672] {336}	14,051 (2,810) [674] {337}	14,092 (2,818) [676] {338}
Davidson	80,451	80,598	80,790	81,042	81,403 (16,281) [3,907] {1,954}	81,744 (16,349) [3,924] {1,962}	82,070 (16,414) [3,939] {1,970}
Hamilton	39,815	39,899	39,979	40,069	40,233 (8,047) [1,931] {966}	40,389 (8,078) [1,939] {969}	40,536 (8,107) [1,946] {973}
Knox	45,057	45,139	45,241	45,328	45,555 (9,111) [2,187] {1,093}	45,768 (9,154) [2,197] {1,098}	45,970 (9,194) [2,207] {1,103}
Rutherford	37,705	37,781	37,906	38,014	38,184 (7,637) [1,833] {916}	38,349 (7,670) [1,841] {920}	38,507 (7,701) [1,848] {924}
Shelby	86,235	86,383	86,600	86,794	87,104 (17,421) [4,181] {2,090}	87,401 (17,480) [4,195] {2,098}	87,685 (17,537) [4,209] {2,104}
Sumner	21,081	21,120	21,166	21,216	21,324 (4,265) [1,024] {512}	21,424 (4,285) [1,028] {514}	21,520 (4,304) [1,033] {516}
Williamson	24,880	24,944	25,011	25,081	25,181 (5,036) [1,209] {604}	25,277 (5,055) [1,213] {607}	25,367 (5,073) [1,218] {609}

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.