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

Date: 12/1/20

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 12/1/20 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.

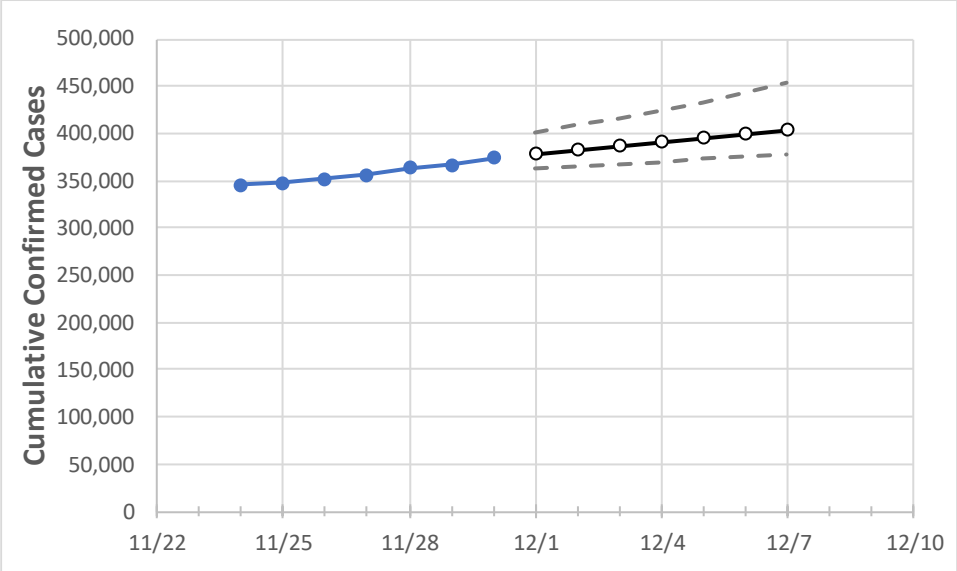
IEM's Modeling Lead

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:						
	11/27	11/28	11/29	11/30	12/1	12/2	12/3	12/4	12/5	12/6	12/7
Tennessee	356,716	363,466	366,518	374,493	378,504	382,579	386,716	390,917	395,180	399,507	403,898

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:						
	11/27	11/28	11/29	11/30	12/1	12/2	12/3	12/4	12/5	12/6	12/7
Blount	5,406	5,491	5,531	5,752	5,839	5,928	6,019	6,112	6,206	6,303	6,401
Davidson	42,057	42,703	42,880	43,546	43,782	44,015	44,247	44,478	44,706	44,933	45,158
Hamilton	16,555	16,701	16,861	17,311	17,502	17,696	17,895	18,096	18,301	18,510	18,723
Knox	18,467	18,764	18,930	19,358	19,581	19,807	20,037	20,271	20,508	20,750	20,995
Rutherford	17,439	17,749	17,930	18,248	18,394	18,539	18,684	18,828	18,970	19,112	19,254
Shelby	47,088	47,682	47,963	48,561	48,926	49,296	49,671	50,052	50,438	50,829	51,226
Sumner	9,573	9,744	9,817	10,123	10,246	10,370	10,495	10,621	10,747	10,875	11,003
Williamson	11,167	11,400	11,490	11,680	11,788	11,897	12,005	12,113	12,220	12,328	12,436

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:		
	11/27	11/28	11/29	11/30	12/2	12/4	12/6
Blount	5,406	5,491	5,531	5,752	5,928 (1,186) [285] {142}	6,112 (1,222) [293] {147}	6,303 (1,261) [303] {151}
Davidson	42,057	42,703	42,880	43,546	44,015 (8,803) [2,113] {1,056}	44,478 (8,896) [2,135] {1,067}	44,933 (8,987) [2,157] {1,078}
Hamilton	16,555	16,701	16,861	17,311	17,696 (3,539) [849] {425}	18,096 (3,619) [869] {434}	18,510 (3,702) [889] {444}
Knox	18,467	18,764	18,930	19,358	19,807 (3,961) [951] {475}	20,271 (4,054) [973] {487}	20,750 (4,150) [996] {498}
Rutherford	17,439	17,749	17,930	18,248	18,539 (3,708) [890] {445}	18,828 (3,766) [904] {452}	19,112 (3,822) [917] {459}
Shelby	47,088	47,682	47,963	48,561	49,296 (9,859) [2,366] {1,183}	50,052 (10,010) [2,402] {1,201}	50,829 (10,166) [2,440] {1,220}
Sumner	9,573	9,744	9,817	10,123	10,370 (2,074) [498] {249}	10,621 (2,124) [510] {255}	10,875 (2,175) [522] {261}
Williamson	11,167	11,400	11,490	11,680	11,897 (2,379) [571] {286}	12,113 (2,423) [581] {291}	12,328 (2,466) [592] {296}

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.