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

Date: 1/21/21

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 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 1/21/21 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.

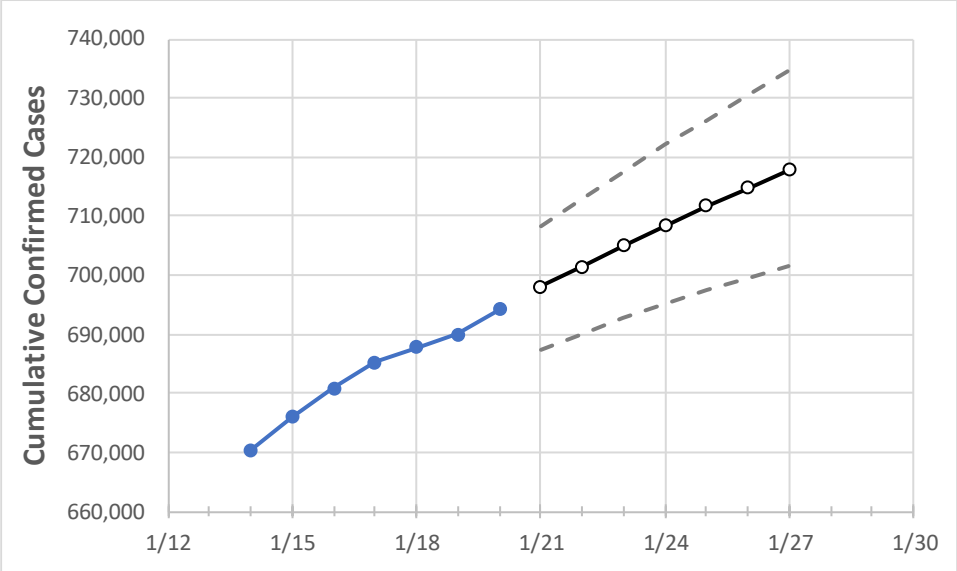
IEM's Modeling Lead

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:						
	1/17	1/18	1/19	1/20	1/21	1/22	1/23	1/24	1/25	1/26	1/27
Tennessee	685,321	687,751	690,065	694,291	698,039	701,548	705,003	708,386	711,697	714,871	717,892

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:						
	1/17	1/18	1/19	1/20	1/21	1/22	1/23	1/24	1/25	1/26	1/27
Blount	11,887	11,914	12,029	12,146	12,240	12,335	12,432	12,526	12,622	12,718	12,812
Davidson	70,706	70,950	71,148	71,578	71,987	72,386	72,791	73,178	73,549	73,918	74,290
Hamilton	34,556	34,687	34,813	35,049	35,277	35,486	35,696	35,901	36,104	36,288	36,470
Knox	38,646	38,829	38,985	39,306	39,556	39,803	40,044	40,270	40,490	40,711	40,922
Rutherford	33,114	33,228	33,298	33,516	33,703	33,885	34,058	34,228	34,393	34,558	34,717
Shelby	76,167	76,519	76,747	77,157	77,543	77,921	78,282	78,639	78,985	79,330	79,654
Sumner	18,205	18,262	18,322	18,454	18,550	18,645	18,738	18,830	18,918	18,999	19,080
Williamson	21,364	21,449	21,507	21,679	21,801	21,917	22,028	22,137	22,242	22,338	22,433

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:		
	1/17	1/18	1/19	1/20	1/22	1/24	1/26
Blount	11,887	11,914	12,029	12,146	12,335 (2,467) [592] {296}	12,526 (2,505) [601] {301}	12,718 (2,544) [610] {305}
Davidson	70,706	70,950	71,148	71,578	72,386 (14,477) [3,475] {1,737}	73,178 (14,636) [3,513] {1,756}	73,918 (14,784) [3,548] {1,774}
Hamilton	34,556	34,687	34,813	35,049	35,486 (7,097) [1,703] {852}	35,901 (7,180) [1,723] {862}	36,288 (7,258) [1,742] {871}
Knox	38,646	38,829	38,985	39,306	39,803 (7,961) [1,911] {955}	40,270 (8,054) [1,933] {966}	40,711 (8,142) [1,954] {977}
Rutherford	33,114	33,228	33,298	33,516	33,885 (6,777) [1,626] {813}	34,228 (6,846) [1,643] {821}	34,558 (6,912) [1,659] {829}
Shelby	76,167	76,519	76,747	77,157	77,921 (15,584) [3,740] {1,870}	78,639 (15,728) [3,775] {1,887}	79,330 (15,866) [3,808] {1,904}
Sumner	18,205	18,262	18,322	18,454	18,645 (3,729) [895] {447}	18,830 (3,766) [904] {452}	18,999 (3,800) [912] {456}
Williamson	21,364	21,449	21,507	21,679	21,917 (4,383) [1,052] {526}	22,137 (4,427) [1,063] {531}	22,338 (4,468) [1,072] {536}

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.