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

Date: 1/20/21

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 1/20/21 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.

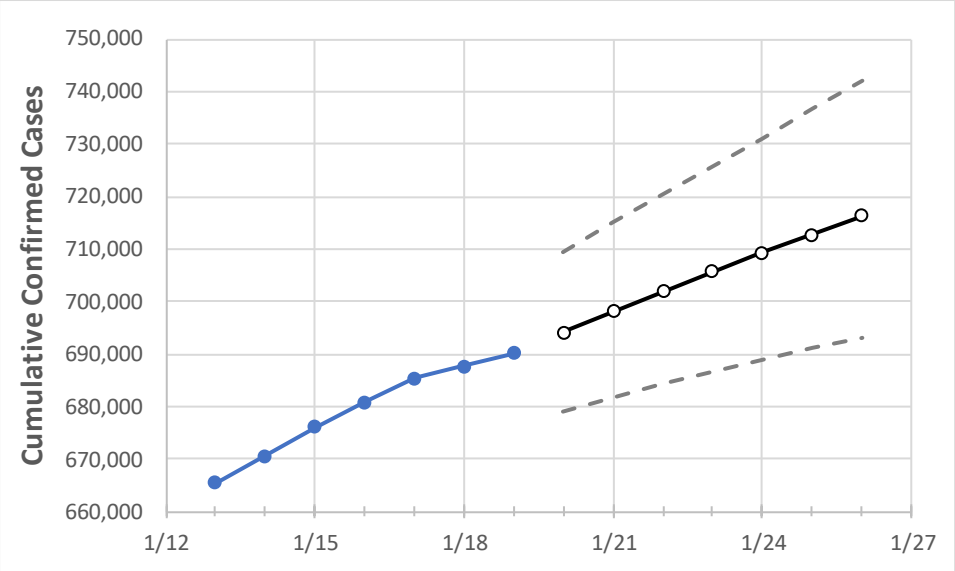
IEM's Modeling Lead

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:						
	1/16	1/17	1/18	1/19	1/20	1/21	1/22	1/23	1/24	1/25	1/26
Tennessee	680,847	685,321	687,751	690,065	694,126	698,067	701,965	705,729	709,348	712,772	716,318

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:						
	1/16	1/17	1/18	1/19	1/20	1/21	1/22	1/23	1/24	1/25	1/26
Blount	11,784	11,887	11,914	12,029	12,122	12,215	12,305	12,393	12,480	12,567	12,655
Davidson	70,180	70,706	70,950	71,148	71,580	71,994	72,401	72,793	73,187	73,565	73,922
Hamilton	34,288	34,556	34,687	34,813	35,050	35,283	35,505	35,721	35,930	36,141	36,337
Knox	38,327	38,646	38,829	38,985	39,240	39,490	39,732	39,973	40,201	40,429	40,646
Rutherford	32,907	33,114	33,228	33,298	33,495	33,689	33,875	34,061	34,241	34,417	34,587
Shelby	75,747	76,167	76,519	76,747	77,132	77,510	77,882	78,250	78,595	78,928	79,247
Sumner	18,067	18,205	18,262	18,322	18,419	18,517	18,611	18,701	18,789	18,876	18,961
Williamson	21,226	21,364	21,449	21,507	21,628	21,745	21,859	21,969	22,074	22,176	22,270

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:		
	1/16	1/17	1/18	1/19	1/21	1/23	1/25
Blount	11,784	11,887	11,914	12,029	12,215 (2,443) [586] {293}	12,393 (2,479) [595] {297}	12,567 (2,513) [603] {302}
Davidson	70,180	70,706	70,950	71,148	71,994 (14,399) [3,456] {1,728}	72,793 (14,559) [3,494] {1,747}	73,565 (14,713) [3,531] {1,766}
Hamilton	34,288	34,556	34,687	34,813	35,283 (7,057) [1,694] {847}	35,721 (7,144) [1,715] {857}	36,141 (7,228) [1,735] {867}
Knox	38,327	38,646	38,829	38,985	39,490 (7,898) [1,896] {948}	39,973 (7,995) [1,919] {959}	40,429 (8,086) [1,941] {970}
Rutherford	32,907	33,114	33,228	33,298	33,689 (6,738) [1,617] {809}	34,061 (6,812) [1,635] {817}	34,417 (6,883) [1,652] {826}
Shelby	75,747	76,167	76,519	76,747	77,510 (15,502) [3,720] {1,860}	78,250 (15,650) [3,756] {1,878}	78,928 (15,786) [3,789] {1,894}
Sumner	18,067	18,205	18,262	18,322	18,517 (3,703) [889] {444}	18,701 (3,740) [898] {449}	18,876 (3,775) [906] {453}
Williamson	21,226	21,364	21,449	21,507	21,745 (4,349) [1,044] {522}	21,969 (4,394) [1,055] {527}	22,176 (4,435) [1,064] {532}

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.