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

Date: 1/12/21

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 1/12/21 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.

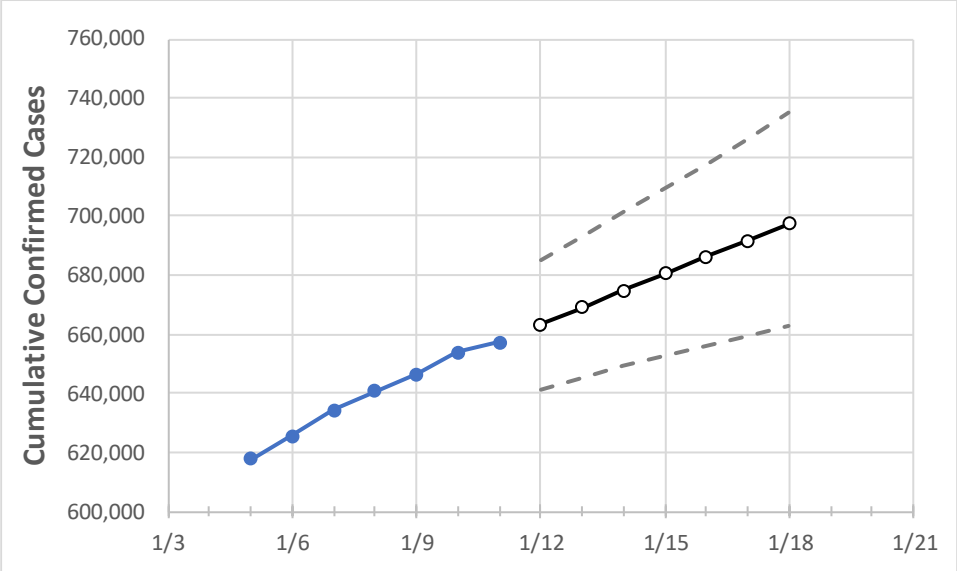
IEM's Modeling Lead

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:						
	1/8	1/9	1/10	1/11	1/12	1/13	1/14	1/15	1/16	1/17	1/18
Tennessee	640,606	646,450	653,869	657,396	663,224	669,036	674,756	680,663	686,226	691,821	697,609

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:						
	1/8	1/9	1/10	1/11	1/12	1/13	1/14	1/15	1/16	1/17	1/18
Blount	10,905	11,013	11,127	11,203	11,312	11,419	11,525	11,629	11,732	11,837	11,935
Davidson	66,301	66,901	67,645	67,992	68,538	69,080	69,610	70,138	70,690	71,215	71,752
Hamilton	31,775	32,082	32,446	32,715	33,093	33,464	33,841	34,219	34,612	35,007	35,401
Knox	35,907	36,306	36,717	36,973	37,353	37,726	38,102	38,471	38,851	39,223	39,588
Rutherford	30,893	31,214	31,563	31,744	32,013	32,272	32,532	32,794	33,055	33,312	33,571
Shelby	71,590	72,183	72,840	73,322	73,876	74,442	74,996	75,530	76,077	76,645	77,177
Sumner	17,105	17,243	17,405	17,473	17,605	17,735	17,870	18,003	18,131	18,260	18,390
Williamson	19,897	20,063	20,319	20,470	20,702	20,931	21,164	21,392	21,628	21,855	22,085

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:		
	1/8	1/9	1/10	1/11	1/13	1/15	1/17
Blount	10,905	11,013	11,127	11,203	11,419 (2,284) [548] {274}	11,629 (2,326) [558] {279}	11,837 (2,367) [568] {284}
Davidson	66,301	66,901	67,645	67,992	69,080 (13,816) [3,316] {1,658}	70,138 (14,028) [3,367] {1,683}	71,215 (14,243) [3,418] {1,709}
Hamilton	31,775	32,082	32,446	32,715	33,464 (6,693) [1,606] {803}	34,219 (6,844) [1,643] {821}	35,007 (7,001) [1,680] {840}
Knox	35,907	36,306	36,717	36,973	37,726 (7,545) [1,811] {905}	38,471 (7,694) [1,847] {923}	39,223 (7,845) [1,883] {941}
Rutherford	30,893	31,214	31,563	31,744	32,272 (6,454) [1,549] {775}	32,794 (6,559) [1,574] {787}	33,312 (6,662) [1,599] {799}
Shelby	71,590	72,183	72,840	73,322	74,442 (14,888) [3,573] {1,787}	75,530 (15,106) [3,625] {1,813}	76,645 (15,329) [3,679] {1,839}
Sumner	17,105	17,243	17,405	17,473	17,735 (3,547) [851] {426}	18,003 (3,601) [864] {432}	18,260 (3,652) [877] {438}
Williamson	19,897	20,063	20,319	20,470	20,931 (4,186) [1,005] {502}	21,392 (4,278) [1,027] {513}	21,855 (4,371) [1,049] {525}

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.