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

Date: 2/3/21

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 2/3/21 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.

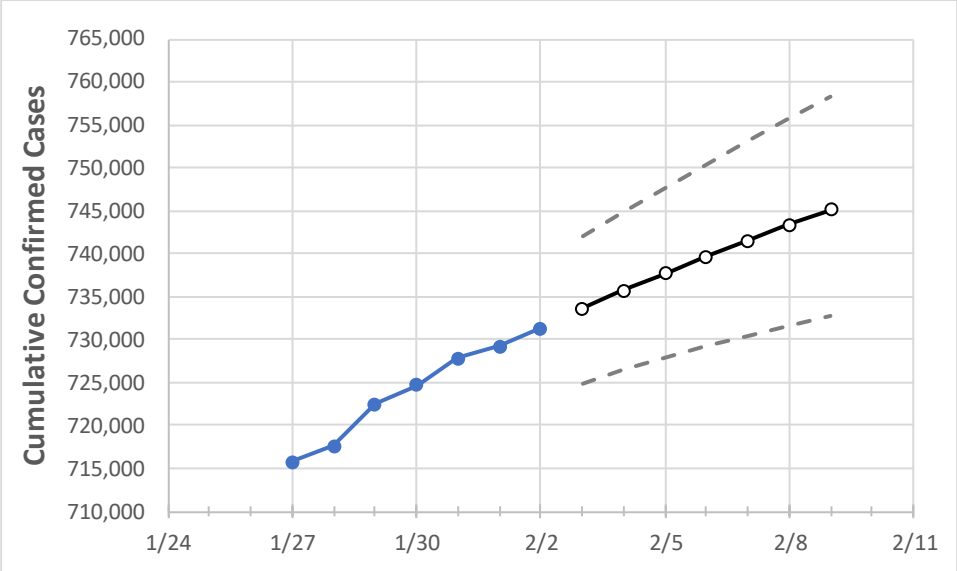
IEM's Modeling Lead

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:						
	1/30	1/31	2/1	2/2	2/3	2/4	2/5	2/6	2/7	2/8	2/9
Tennessee	724,742	727,861	729,187	731,360	733,620	735,770	737,739	739,703	741,513	743,372	745,139

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:						
	1/30	1/31	2/1	2/2	2/3	2/4	2/5	2/6	2/7	2/8	2/9
Blount	12,622	12,645	12,668	12,701	12,733	12,763	12,792	12,818	12,844	12,869	12,892
Davidson	74,643	74,925	75,072	75,210	75,422	75,624	75,822	76,019	76,198	76,369	76,540
Hamilton	36,908	37,038	37,122	37,296	37,426	37,551	37,671	37,787	37,896	38,003	38,106
Knox	41,204	41,438	41,544	41,732	41,879	42,024	42,164	42,299	42,430	42,558	42,678
Rutherford	34,951	35,110	35,188	35,299	35,403	35,505	35,604	35,698	35,791	35,878	35,969
Shelby	80,588	80,954	81,138	81,360	81,616	81,867	82,110	82,353	82,578	82,808	83,026
Sumner	19,210	19,283	19,339	19,414	19,473	19,528	19,581	19,635	19,685	19,730	19,778
Williamson	22,845	22,987	23,070	23,162	23,257	23,347	23,437	23,523	23,608	23,694	23,780

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:		
	1/30	1/31	2/1	2/2	2/4	2/6	2/8
Blount	12,622	12,645	12,668	12,701	12,763 (2,553) [613] {306}	12,818 (2,564) [615] {308}	12,869 (2,574) [618] {309}
Davidson	74,643	74,925	75,072	75,210	75,624 (15,125) [3,630] {1,815}	76,019 (15,204) [3,649] {1,824}	76,369 (15,274) [3,666] {1,833}
Hamilton	36,908	37,038	37,122	37,296	37,551 (7,510) [1,802] {901}	37,787 (7,557) [1,814] {907}	38,003 (7,601) [1,824] {912}
Knox	41,204	41,438	41,544	41,732	42,024 (8,405) [2,017] {1,009}	42,299 (8,460) [2,030] {1,015}	42,558 (8,512) [2,043] {1,021}
Rutherford	34,951	35,110	35,188	35,299	35,505 (7,101) [1,704] {852}	35,698 (7,140) [1,713] {857}	35,878 (7,176) [1,722] {861}
Shelby	80,588	80,954	81,138	81,360	81,867 (16,373) [3,930] {1,965}	82,353 (16,471) [3,953] {1,976}	82,808 (16,562) [3,975] {1,987}
Sumner	19,210	19,283	19,339	19,414	19,528 (3,906) [937] {469}	19,635 (3,927) [942] {471}	19,730 (3,946) [947] {474}
Williamson	22,845	22,987	23,070	23,162	23,347 (4,669) [1,121] {560}	23,523 (4,705) [1,129] {565}	23,694 (4,739) [1,137] {569}

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.