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

Date: 12/9/20

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 12/9/20 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.

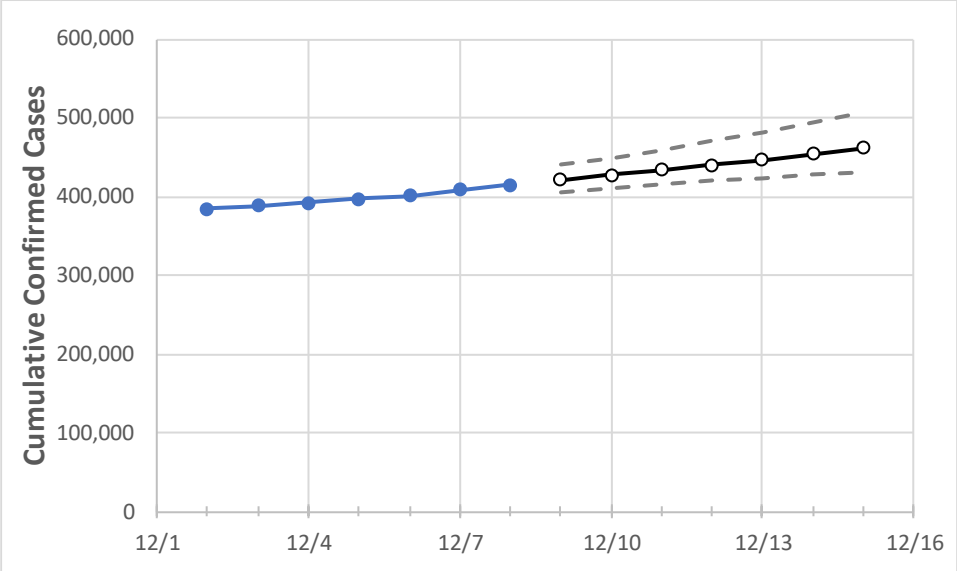
IEM's Modeling Lead

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:						
	12/5	12/6	12/7	12/8	12/9	12/10	12/11	12/12	12/13	12/14	12/15
Tennessee	397,522	400,594	408,730	414,749	420,760	426,990	433,444	440,129	447,051	454,217	461,635

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:						
	12/5	12/6	12/7	12/8	12/9	12/10	12/11	12/12	12/13	12/14	12/15
Blount	6,283	6,377	6,559	6,669	6,792	6,919	7,050	7,186	7,327	7,473	7,624
Davidson	45,733	45,923	46,491	46,929	47,428	47,948	48,490	49,055	49,644	50,257	50,896
Hamilton	18,656	18,824	19,107	19,417	19,729	20,054	20,391	20,742	21,107	21,486	21,879
Knox	21,003	21,218	21,696	22,084	22,492	22,917	23,361	23,825	24,309	24,813	25,340
Rutherford	19,456	19,594	20,061	20,346	20,661	20,990	21,335	21,697	22,075	22,471	22,885
Shelby	50,688	51,030	51,550	52,068	52,601	53,151	53,718	54,302	54,904	55,525	56,164
Sumner	10,851	10,928	11,148	11,380	11,555	11,735	11,920	12,111	12,307	12,508	12,715
Williamson	12,370	12,426	12,638	12,804	12,954	13,107	13,263	13,421	13,582	13,745	13,912

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:		
	12/5	12/6	12/7	12/8	12/10	12/12	12/14
Blount	6,283	6,377	6,559	6,669	6,919 (1,384) [332] {166}	7,186 (1,437) [345] {172}	7,473 (1,495) [359] {179}
Davidson	45,733	45,923	46,491	46,929	47,948 (9,590) [2,301] {1,151}	49,055 (9,811) [2,355] {1,177}	50,257 (10,051) [2,412] {1,206}
Hamilton	18,656	18,824	19,107	19,417	20,054 (4,011) [963] {481}	20,742 (4,148) [996] {498}	21,486 (4,297) [1,031] {516}
Knox	21,003	21,218	21,696	22,084	22,917 (4,583) [1,100] {550}	23,825 (4,765) [1,144] {572}	24,813 (4,963) [1,191] {596}
Rutherford	19,456	19,594	20,061	20,346	20,990 (4,198) [1,008] {504}	21,697 (4,339) [1,041] {521}	22,471 (4,494) [1,079] {539}
Shelby	50,688	51,030	51,550	52,068	53,151 (10,630) [2,551] {1,276}	54,302 (10,860) [2,607] {1,303}	55,525 (11,105) [2,665] {1,333}
Sumner	10,851	10,928	11,148	11,380	11,735 (2,347) [563] {282}	12,111 (2,422) [581] {291}	12,508 (2,502) [600] {300}
Williamson	12,370	12,426	12,638	12,804	13,107 (2,621) [629] {315}	13,421 (2,684) [644] {322}	13,745 (2,749) [660] {330}

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.