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

Date: 2/24/21

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 2/24/21 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.

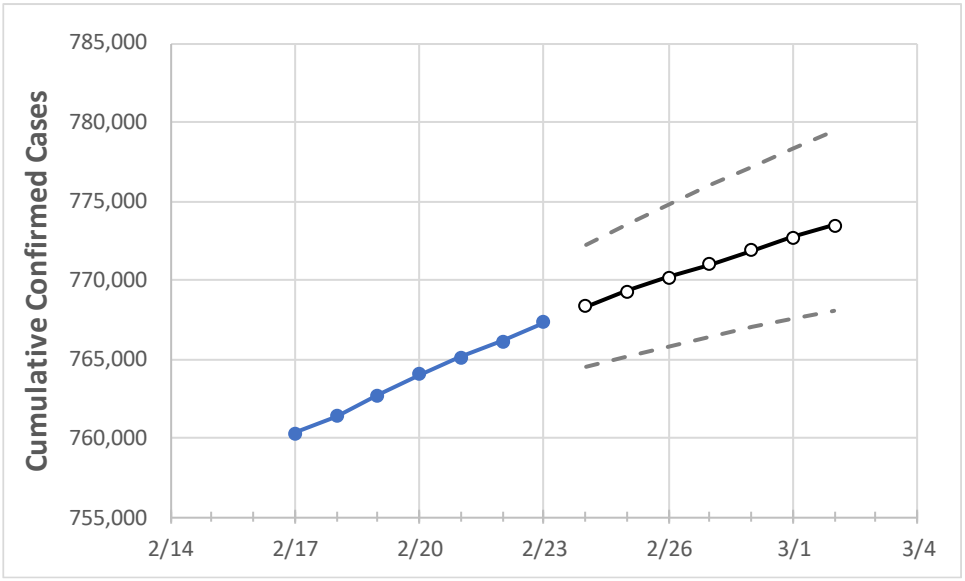
IEM's Modeling Lead

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:						
	2/20	2/21	2/22	2/23	2/24	2/25	2/26	2/27	2/28	3/1	3/2
Tennessee	764,008	765,137	766,089	767,315	768,316	769,267	770,173	771,014	771,893	772,691	773,492

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:						
	2/20	2/21	2/22	2/23	2/24	2/25	2/26	2/27	2/28	3/1	3/2
Blount	13,849	13,868	13,880	13,905	13,954	14,002	14,048	14,092	14,138	14,183	14,227
Davidson	80,243	80,349	80,451	80,598	80,828	81,059	81,297	81,521	81,752	81,971	82,200
Hamilton	39,675	39,728	39,815	39,899	39,988	40,078	40,166	40,252	40,332	40,414	40,494
Knox	44,876	44,982	45,057	45,139	45,269	45,399	45,523	45,647	45,769	45,887	46,005
Rutherford	37,552	37,626	37,705	37,781	37,882	37,981	38,081	38,179	38,274	38,372	38,466
Shelby	86,027	86,134	86,235	86,383	86,560	86,731	86,905	87,073	87,235	87,396	87,549
Sumner	21,030	21,064	21,081	21,120	21,186	21,249	21,316	21,381	21,446	21,510	21,571
Williamson	24,762	24,822	24,880	24,944	25,002	25,059	25,115	25,170	25,222	25,273	25,326

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:		
	2/20	2/21	2/22	2/23	2/25	2/27	3/1
Blount	13,849	13,868	13,880	13,905	14,002 (2,800) [672] {336}	14,092 (2,818) [676] {338}	14,183 (2,837) [681] {340}
Davidson	80,243	80,349	80,451	80,598	81,059 (16,212) [3,891] {1,945}	81,521 (16,304) [3,913] {1,956}	81,971 (16,394) [3,935] {1,967}
Hamilton	39,675	39,728	39,815	39,899	40,078 (8,016) [1,924] {962}	40,252 (8,050) [1,932] {966}	40,414 (8,083) [1,940] {970}
Knox	44,876	44,982	45,057	45,139	45,399 (9,080) [2,179] {1,090}	45,647 (9,129) [2,191] {1,096}	45,887 (9,177) [2,203] {1,101}
Rutherford	37,552	37,626	37,705	37,781	37,981 (7,596) [1,823] {912}	38,179 (7,636) [1,833] {916}	38,372 (7,674) [1,842] {921}
Shelby	86,027	86,134	86,235	86,383	86,731 (17,346) [4,163] {2,082}	87,073 (17,415) [4,179] {2,090}	87,396 (17,479) [4,195] {2,098}
Sumner	21,030	21,064	21,081	21,120	21,249 (4,250) [1,020] {510}	21,381 (4,276) [1,026] {513}	21,510 (4,302) [1,032] {516}
Williamson	24,762	24,822	24,880	24,944	25,059 (5,012) [1,203] {601}	25,170 (5,034) [1,208] {604}	25,273 (5,055) [1,213] {607}

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.