IEM's AI Modeling: Short-term COVID-19 Projections
Date: 2/11/22

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 <u>not</u> 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 2/11/22 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
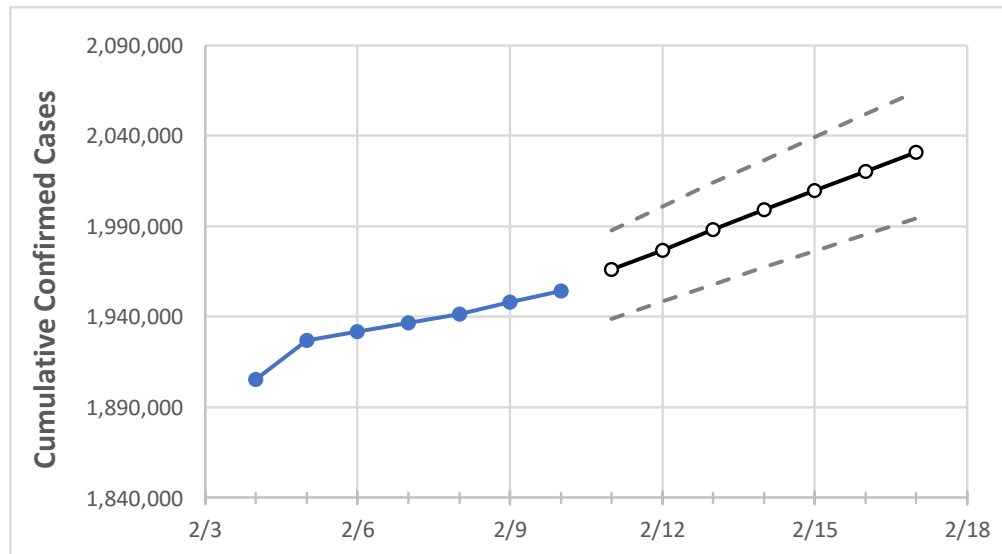
	Actual Confirmed Cases On:				Projected Cases For:						
	2/7	2/8	2/9	2/10	2/11	2/12	2/13	2/14	2/15	2/16	2/17
Tennessee	1,936,573	1,941,348	1,947,865	1,954,202	1,966,029	1,976,856	1,987,957	1,999,105	2,009,883	2,020,215	2,030,757

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:						
	2/7	2/8	2/9	2/10	2/11	2/12	2/13	2/14	2/15	2/16	2/17
Blount	36,943	37,257	37,570	37,570	37,865	38,159	38,448	38,734	39,019	39,299	39,576
Davidson	182,902	183,637	184,371	184,371	185,045	185,688	186,322	186,939	187,536	188,131	188,707
Hamilton	93,698	94,166	94,633	94,633	95,056	95,467	95,871	96,268	96,659	97,039	97,417
Knox	119,756	120,646	121,536	121,536	122,360	123,182	123,990	124,788	125,584	126,370	127,147
Rutherford	91,825	92,271	92,717	92,717	93,126	93,525	93,910	94,288	94,663	95,039	95,409
Shelby	227,789	228,468	229,147	229,147	229,758	230,340	230,904	231,454	231,986	232,491	232,988
Sumner	50,820	51,108	51,397	51,397	51,667	51,937	52,207	52,469	52,732	52,991	53,249
Williamson	59,259	59,569	59,879	59,879	60,162	60,440	60,711	60,977	61,241	61,502	61,759

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:		
	2/7	2/8	2/9	2/10	2/12	2/14	2/16
Blount	36,943	37,257	37,570	37,570	38,159 (7,632) [1,832] {916}	38,734 (7,747) [1,859] {930}	39,299 (7,860) [1,886] {943}
Davidson	182,902	183,637	184,371	184,371	185,688 (37,138) [8,913] {4,457}	186,939 (37,388) [8,973] {4,487}	188,131 (37,626) [9,030] {4,515}
Hamilton	93,698	94,166	94,633	94,633	95,467 (19,093) [4,582] {2,291}	96,268 (19,254) [4,621] {2,310}	97,039 (19,408) [4,658] {2,329}
Knox	119,756	120,646	121,536	121,536	123,182 (24,636) [5,913] {2,956}	124,788 (24,958) [5,990] {2,995}	126,370 (25,274) [6,066] {3,033}
Rutherford	91,825	92,271	92,717	92,717	93,525 (18,705) [4,489] {2,245}	94,288 (18,858) [4,526] {2,263}	95,039 (19,008) [4,562] {2,281}
Shelby	227,789	228,468	229,147	229,147	230,340 (46,068) [11,056] {5,528}	231,454 (46,291) [11,110] {5,555}	232,491 (46,498) [11,160] {5,580}
Sumner	50,820	51,108	51,397	51,397	51,937 (10,387) [2,493] {1,246}	52,469 (10,494) [2,519] {1,259}	52,991 (10,598) [2,544] {1,272}
Williamson	59,259	59,569	59,879	59,879	60,440 (12,088) [2,901] {1,451}	60,977 (12,195) [2,927] {1,463}	61,502 (12,300) [2,952] {1,476}

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.