IEM's AI Modeling: Short-term COVID-19 Projections
Date: 12/17/20

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 12/17/20 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
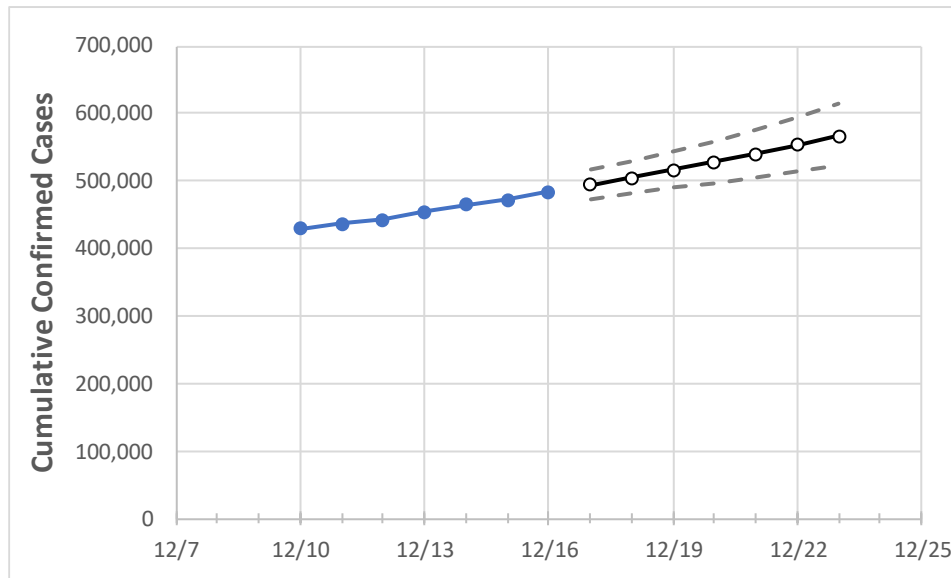
	Actual Confirmed Cases On:				Projected Cases For:						
	12/13	12/14	12/15	12/16	12/17	12/18	12/19	12/20	12/21	12/22	12/23
Tennessee	454,305	464,624	472,875	484,285	494,483	505,189	516,419	528,193	540,529	553,448	566,974

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:						
	12/13	12/14	12/15	12/16	12/17	12/18	12/19	12/20	12/21	12/22	12/23
Blount	7,342	7,534	7,610	7,823	7,984	8,151	8,323	8,501	8,684	8,872	9,067
Davidson	50,108	50,898	51,549	52,439	53,182	53,953	54,755	55,587	56,450	57,346	58,275
Hamilton	21,119	21,535	21,969	22,532	23,012	23,516	24,046	24,602	25,186	25,799	26,442
Knox	24,409	24,944	25,478	26,179	26,799	27,448	28,129	28,841	29,587	30,369	31,186
Rutherford	22,336	22,904	23,272	23,828	24,319	24,833	25,371	25,932	26,519	27,132	27,772
Shelby	55,456	56,311	56,987	58,127	58,958	59,825	60,730	61,675	62,659	63,686	64,756
Sumner	12,456	12,762	12,925	13,216	13,467	13,727	13,995	14,271	14,556	14,851	15,154
Williamson	13,786	14,002	14,232	14,557	14,807	15,067	15,337	15,618	15,911	16,215	16,530

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: | | |
	12/13	12/14	12/15	12/16	12/18	12/20	12/22
Blount	7,342	7,534	7,610	7,823	8,151 (1,630) [391] {196}	8,501 (1,700) [408] {204}	8,872 (1,774) [426] {213}
Davidson	50,108	50,898	51,549	52,439	53,953 (10,791) [2,590] {1,295}	55,587 (11,117) [2,668] {1,334}	57,346 (11,469) [2,753] {1,376}
Hamilton	21,119	21,535	21,969	22,532	23,516 (4,703) [1,129] {564}	24,602 (4,920) [1,181] {590}	25,799 (5,160) [1,238] {619}
Knox	24,409	24,944	25,478	26,179	27,448 (5,490) [1,318] {659}	28,841 (5,768) [1,384] {692}	30,369 (6,074) [1,458] {729}
Rutherford	22,336	22,904	23,272	23,828	24,833 (4,967) [1,192] {596}	25,932 (5,186) [1,245] {622}	27,132 (5,426) [1,302] {651}
Shelby	55,456	56,311	56,987	58,127	59,825 (11,965) [2,872] {1,436}	61,675 (12,335) [2,960] {1,480}	63,686 (12,737) [3,057] {1,528}
Sumner	12,456	12,762	12,925	13,216	13,727 (2,745) [659] {329}	14,271 (2,854) [685] {343}	14,851 (2,970) [713] {356}
Williamson	13,786	14,002	14,232	14,557	15,067 (3,013) [723] {362}	15,618 (3,124) [750] {375}	16,215 (3,243) [778] {389}

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.