IEM's AI Modeling: Short-term COVID-19 Projections
Date: 12/18/20

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 <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 12/18/20 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.

Missouri State Projections
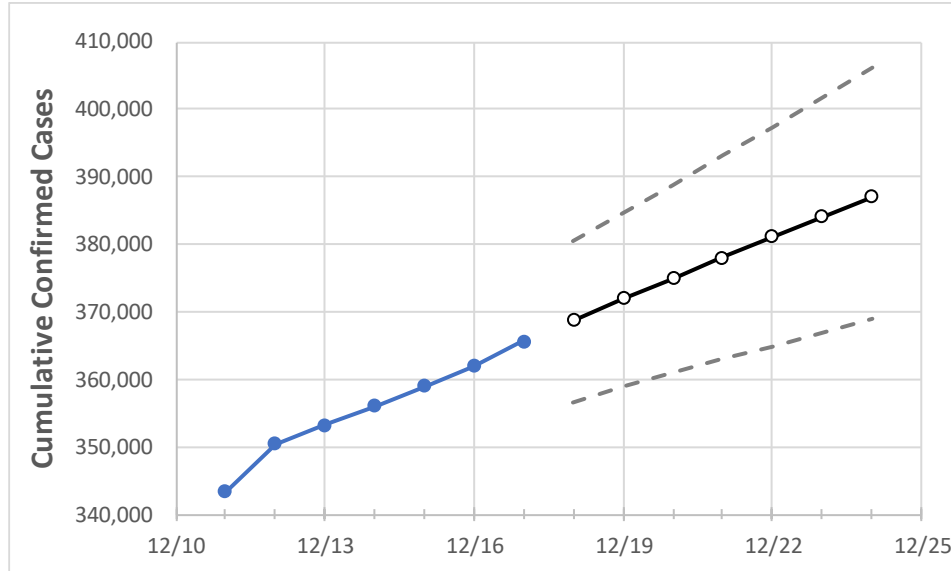
	Actual Confirmed Cases On:				Projected Cases For:						
	12/14	12/15	12/16	12/17	12/18	12/19	12/20	12/21	12/22	12/23	12/24
Missouri	356,107	359,022	361,888	365,678	368,821	371,936	375,023	378,082	381,112	384,113	387,087

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.

Missouri Counties

	Actual Confirmed Cases On:				Projected Cases For:						
	12/14	12/15	12/16	12/17	12/18	12/19	12/20	12/21	12/22	12/23	12/24
Boone	11,841	11,879	12,059	12,177	12,274	12,370	12,466	12,561	12,656	12,751	12,846
City of St. Louis	15,070	15,199	15,331	15,471	15,606	15,740	15,873	16,006	16,139	16,271	16,403
Greene	16,366	16,507	16,658	16,926	17,112	17,301	17,491	17,683	17,877	18,073	18,270
Jackson (& KC)	47,419	47,846	48,133	48,529	48,928	49,322	49,711	50,095	50,473	50,847	51,215
St. Charles	23,816	24,057	24,270	24,477	24,699	24,918	25,135	25,349	25,561	25,770	25,977
St. Louis	60,837	61,500	61,978	62,531	63,109	63,681	64,250	64,813	65,373	65,928	66,478

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.*

Missouri Medical Demands by County

	Actual Confirmed Cases On:				Projected Cases (Hospitalized) [ICU] {Ventilator} For:		
	12/14	12/15	12/16	12/17	12/19	12/21	12/23
Boone	11,841	11,879	12,059	12,177	12,370 (2,474) [594] {297}	12,561 (2,512) [603] {301}	12,751 (2,550) [612] {306}
City of St. Louis	15,070	15,199	15,331	15,471	15,740 (3,148) [756] {378}	16,006 (3,201) [768] {384}	16,271 (3,254) [781] {391}
Greene	16,366	16,507	16,658	16,926	17,301 (3,460) [830] {415}	17,683 (3,537) [849] {424}	18,073 (3,615) [867] {434}
Jackson (& KC)	47,419	47,846	48,133	48,529	49,322 (9,864) [2,367] {1,184}	50,095 (10,019) [2,405] {1,202}	50,847 (10,169) [2,441] {1,220}
St. Charles	23,816	24,057	24,270	24,477	24,918 (4,984) [1,196] {598}	25,349 (5,070) [1,217] {608}	25,770 (5,154) [1,237] {618}
St. Louis	60,837	61,500	61,978	62,531	63,681 (12,736) [3,057] {1,528}	64,813 (12,963) [3,111] {1,556}	65,928 (13,186) [3,165] {1,582}

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.