IEM's AI Modeling: Short-term COVID-19 Projections
Date: 4/13/21

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 <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 4/13/21 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.

Missouri State Projections
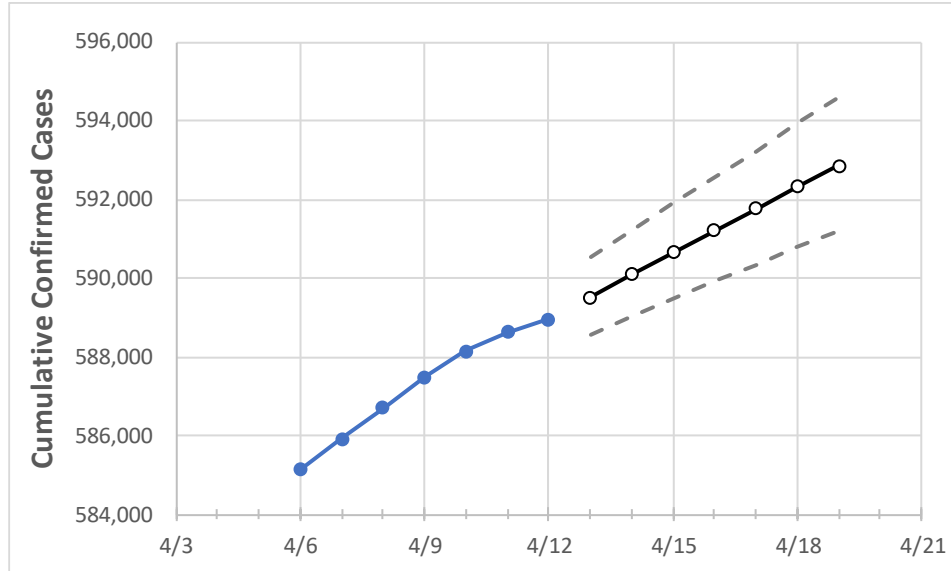
	Actual Confirmed Cases On:				Projected Cases For:						
	4/9	4/10	4/11	4/12	4/13	4/14	4/15	4/16	4/17	4/18	4/19
Missouri	587,476	588,146	588,626	588,962	589,522	590,086	590,649	591,210	591,765	592,316	592,860

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.

Missouri Counties

	Actual Confirmed Cases On:				Projected Cases For:						
	4/9	4/10	4/11	4/12	4/13	4/14	4/15	4/16	4/17	4/18	4/19
Boone	17,678	17,697	17,706	17,712	17,724	17,735	17,747	17,759	17,770	17,782	17,793
City of St. Louis	22,963	22,976	23,053	23,093	23,141	23,189	23,240	23,291	23,344	23,397	23,452
Greene	27,862	27,880	27,889	27,896	27,911	27,926	27,941	27,956	27,971	27,986	28,000
Jackson (& KC)	80,496	80,591	80,645	80,678	80,752	80,825	80,899	80,976	81,050	81,123	81,197
St. Charles	41,854	41,915	41,961	41,988	42,051	42,116	42,179	42,243	42,307	42,371	42,435
St. Louis	94,195	94,377	94,494	94,605	94,765	94,926	95,088	95,249	95,412	95,573	95,737

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:		
	4/9	4/10	4/11	4/12	4/14	4/16	4/18
Boone	17,678	17,697	17,706	17,712	17,735 (3,547) [851] {426}	17,759 (3,552) [852] {426}	17,782 (3,556) [854] {427}
City of St. Louis	22,963	22,976	23,053	23,093	23,189 (4,638) [1,113] {557}	23,291 (4,658) [1,118] {559}	23,397 (4,679) [1,123] {562}
Greene	27,862	27,880	27,889	27,896	27,926 (5,585) [1,340] {670}	27,956 (5,591) [1,342] {671}	27,986 (5,597) [1,343] {672}
Jackson (& KC)	80,496	80,591	80,645	80,678	80,825 (16,165) [3,880] {1,940}	80,976 (16,195) [3,887] {1,943}	81,123 (16,225) [3,894] {1,947}
St. Charles	41,854	41,915	41,961	41,988	42,116 (8,423) [2,022] {1,011}	42,243 (8,449) [2,028] {1,014}	42,371 (8,474) [2,034] {1,017}
St. Louis	94,195	94,377	94,494	94,605	94,926 (18,985) [4,556] {2,278}	95,249 (19,050) [4,572] {2,286}	95,573 (19,115) [4,588] {2,294}

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.