IEM's AI Modeling: Short-term COVID-19 Projections
Date: 1/13/21

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 1/13/21 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
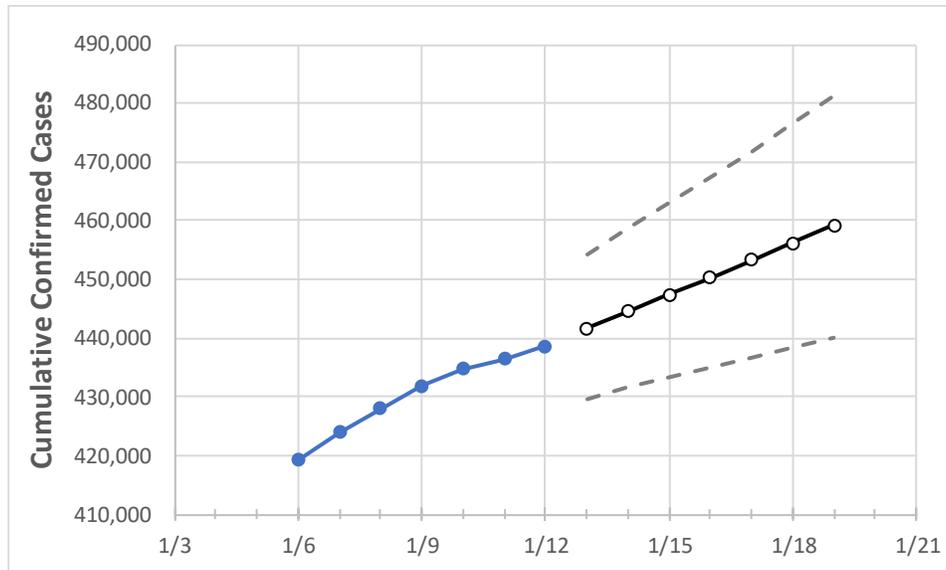
	Actual Confirmed Cases On:				Projected Cases For:						
	1/9	1/10	1/11	1/12	1/13	1/14	1/15	1/16	1/17	1/18	1/19
Missouri	431,943	434,711	436,461	438,663	441,633	444,514	447,348	450,322	453,256	456,221	459,197

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:						
	1/9	1/10	1/11	1/12	1/13	1/14	1/15	1/16	1/17	1/18	1/19
Boone	14,160	14,253	14,285	14,316	14,390	14,465	14,538	14,610	14,680	14,751	14,823
City of St. Louis	17,438	17,446	17,435	17,451	17,482	17,512	17,541	17,567	17,593	17,616	17,638
Greene	20,430	20,542	20,641	20,784	20,956	21,133	21,305	21,479	21,664	21,845	22,027
Jackson (& KC)	57,624	58,124	58,347	58,758	59,194	59,636	60,080	60,526	60,975	61,428	61,880
St. Charles	29,003	29,212	29,317	29,481	29,668	29,854	30,044	30,236	30,428	30,619	30,817
St. Louis	74,745	75,200	75,623	76,107	76,693	77,288	77,894	78,493	79,109	79,721	80,344

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:		
	1/9	1/10	1/11	1/12	1/14	1/16	1/18
Boone	14,160	14,253	14,285	14,316	14,465 (2,893) [694] {347}	14,610 (2,922) [701] {351}	14,751 (2,950) [708] {354}
City of St. Louis	17,438	17,446	17,435	17,451	17,512 (3,502) [841] {420}	17,567 (3,513) [843] {422}	17,616 (3,523) [846] {423}
Greene	20,430	20,542	20,641	20,784	21,133 (4,227) [1,014] {507}	21,479 (4,296) [1,031] {515}	21,845 (4,369) [1,049] {524}
Jackson (& KC)	57,624	58,124	58,347	58,758	59,636 (11,927) [2,863] {1,431}	60,526 (12,105) [2,905] {1,453}	61,428 (12,286) [2,949] {1,474}
St. Charles	29,003	29,212	29,317	29,481	29,854 (5,971) [1,433] {717}	30,236 (6,047) [1,451] {726}	30,619 (6,124) [1,470] {735}
St. Louis	74,745	75,200	75,623	76,107	77,288 (15,458) [3,710] {1,855}	78,493 (15,699) [3,768] {1,884}	79,721 (15,944) [3,827] {1,913}

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.