IEM's AI Modeling: Short-term COVID-19 Projections
Date: 12/4/20

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 12/4/20 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
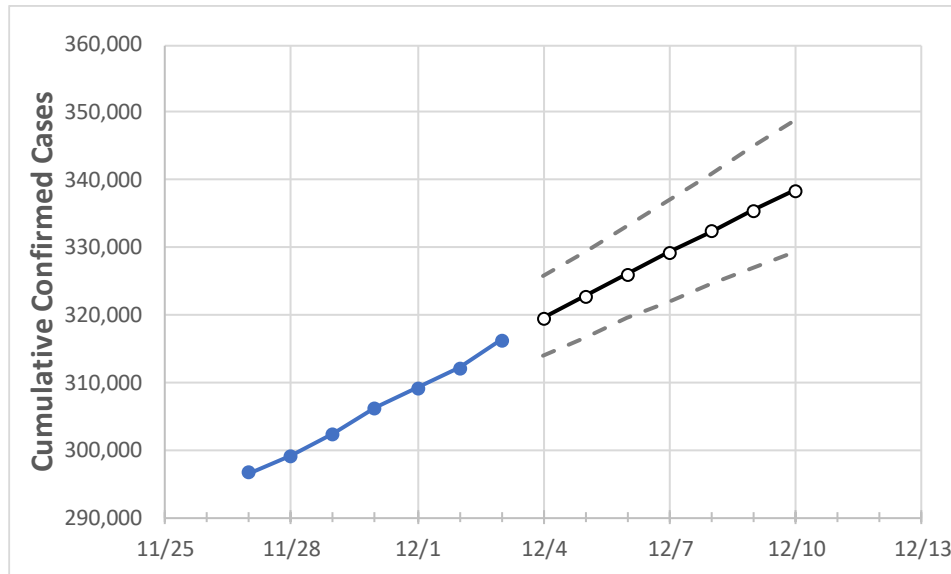
	Actual Confirmed Cases On:				Projected Cases For:						
	11/30	12/1	12/2	12/3	12/4	12/5	12/6	12/7	12/8	12/9	12/10
Missouri	306,206	309,169	312,046	316,235	319,538	322,796	326,009	329,178	332,303	335,385	338,424

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:						
	11/30	12/1	12/2	12/3	12/4	12/5	12/6	12/7	12/8	12/9	12/10
Boone	10,349	10,389	10,577	10,692	10,751	10,809	10,865	10,919	10,972	11,023	11,073
City of St. Louis	13,032	13,188	13,282	13,489	13,638	13,789	13,939	14,091	14,243	14,396	14,549
Greene	14,071	14,166	14,317	14,449	14,579	14,707	14,836	14,964	15,091	15,217	15,343
Jackson (& KC)	40,904	41,375	41,608	42,196	42,620	43,037	43,449	43,854	44,253	44,647	45,034
St. Charles	20,229	20,512	20,741	21,069	21,327	21,582	21,833	22,081	22,325	22,566	22,804
St. Louis	51,819	52,421	52,993	53,688	54,315	54,937	55,554	56,168	56,777	57,381	57,981

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:		
	11/30	12/1	12/2	12/3	12/5	12/7	12/9
Boone	10,349	10,389	10,577	10,692	10,809 (2,162) [519] {259}	10,919 (2,184) [524] {262}	11,023 (2,205) [529] {265}
City of St. Louis	13,032	13,188	13,282	13,489	13,789 (2,758) [662] {331}	14,091 (2,818) [676] {338}	14,396 (2,879) [691] {346}
Greene	14,071	14,166	14,317	14,449	14,707 (2,941) [706] {353}	14,964 (2,993) [718] {359}	15,217 (3,043) [730] {365}
Jackson (& KC)	40,904	41,375	41,608	42,196	43,037 (8,607) [2,066] {1,033}	43,854 (8,771) [2,105] {1,052}	44,647 (8,929) [2,143] {1,072}
St. Charles	20,229	20,512	20,741	21,069	21,582 (4,316) [1,036] {518}	22,081 (4,416) [1,060] {530}	22,566 (4,513) [1,083] {542}
St. Louis	51,819	52,421	52,993	53,688	54,937 (10,987) [2,637] {1,318}	56,168 (11,234) [2,696] {1,348}	57,381 (11,476) [2,754] {1,377}

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.