IEM's AI Modeling: Short-term COVID-19 Projections
Date: 12/29/21

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 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 12/29/21 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.

Michigan State Projections
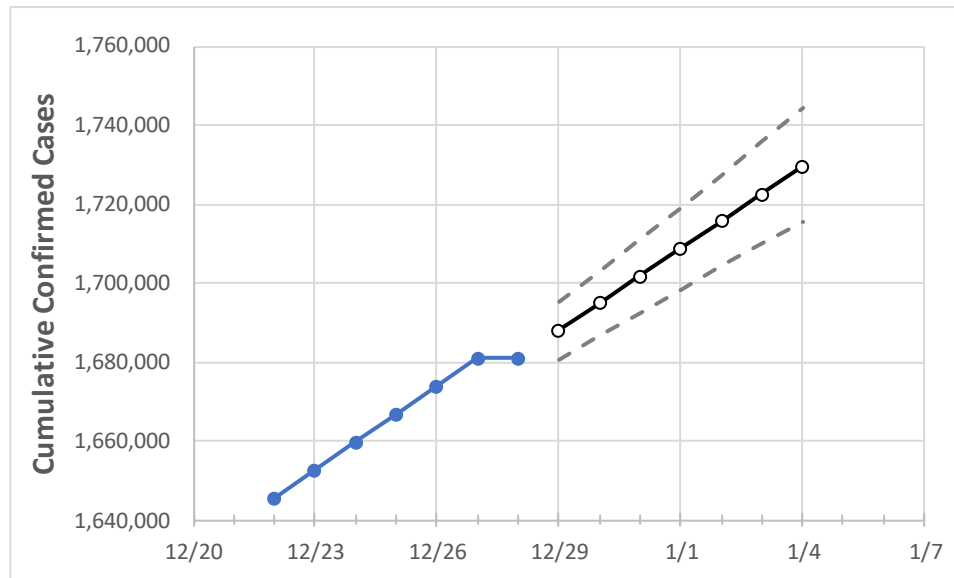
	Actual Confirmed Cases On:				Projected Cases For:						
	12/25	12/26	12/27	12/28	12/29	12/30	12/31	1/1	1/2	1/3	1/4
Michigan	1,666,859	1,673,952	1,681,046	1,681,046	1,687,898	1,694,864	1,701,677	1,708,715	1,715,530	1,722,441	1,729,472

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.

Michigan Counties

	Actual Confirmed Cases On:				Projected Cases For:						
	12/25	12/26	12/27	12/28	12/29	12/30	12/31	1/1	1/2	1/3	1/4
Genesee	70,709	70,943	71,178	71,178	71,428	71,663	71,903	72,140	72,374	72,602	72,825
Ingham	41,104	41,248	41,392	41,392	41,542	41,691	41,840	41,988	42,135	42,287	42,435
Kent	120,483	120,882	121,281	121,281	121,654	122,029	122,406	122,789	123,160	123,548	123,925
Livingston	32,451	32,568	32,685	32,685	32,795	32,902	33,008	33,113	33,218	33,320	33,422
Macomb	160,349	161,288	162,227	162,227	163,292	164,407	165,542	166,725	167,932	169,185	170,439
Monroe	26,669	26,752	26,834	26,834	26,925	27,015	27,104	27,193	27,281	27,370	27,456
Oakland	192,641	193,806	194,971	194,971	196,138	197,323	198,509	199,746	200,990	202,262	203,535
Washtenaw	44,345	44,633	44,921	44,921	45,266	45,624	46,002	46,402	46,813	47,246	47,694
Wayne	264,860	266,833	268,807	268,807	270,893	273,032	275,208	277,423	279,738	282,072	284,436

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.*

Michigan Medical Demands by County

	Actual Confirmed Cases On:				Projected Cases (Hospitalized) [ICU] {Ventilator} For:		
	12/25	12/26	12/27	12/28	12/30	1/1	1/3
Genesee	70,709	70,943	71,178	71,178	71,663 (14,333) [3,440] {1,720}	72,140 (14,428) [3,463] {1,731}	72,602 (14,520) [3,485] {1,742}
Ingham	41,104	41,248	41,392	41,392	41,691 (8,338) [2,001] {1,001}	41,988 (8,398) [2,015] {1,008}	42,287 (8,457) [2,030] {1,015}
Kent	120,483	120,882	121,281	121,281	122,029 (24,406) [5,857] {2,929}	122,789 (24,558) [5,894] {2,947}	123,548 (24,710) [5,930] {2,965}
Livingston	32,451	32,568	32,685	32,685	32,902 (6,580) [1,579] {790}	33,113 (6,623) [1,589] {795}	33,320 (6,664) [1,599] {800}
Macomb	160,349	161,288	162,227	162,227	164,407 (32,881) [7,892] {3,946}	166,725 (33,345) [8,003] {4,001}	169,185 (33,837) [8,121] {4,060}
Monroe	26,669	26,752	26,834	26,834	27,015 (5,403) [1,297] {648}	27,193 (5,439) [1,305] {653}	27,370 (5,474) [1,314] {657}
Oakland	192,641	193,806	194,971	194,971	197,323 (39,465) [9,471] {4,736}	199,746 (39,949) [9,588] {4,794}	202,262 (40,452) [9,709] {4,854}
Washtenaw	44,345	44,633	44,921	44,921	45,624 (9,125) [2,190] {1,095}	46,402 (9,280) [2,227] {1,114}	47,246 (9,449) [2,268] {1,134}
Wayne	264,860	266,833	268,807	268,807	273,032 (54,606) [13,106] {6,553}	277,423 (55,485) [13,316] {6,658}	282,072 (56,414) [13,539] {6,770}

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.