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

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 4/19/21 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
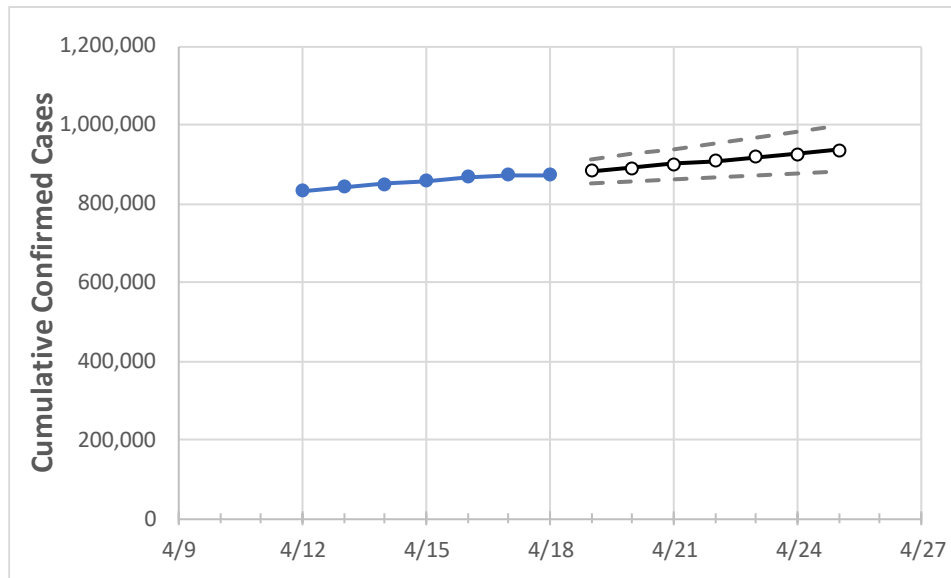
	Actual Confirmed Cases On:				Projected Cases For:						
	4/15	4/16	4/17	4/18	4/19	4/20	4/21	4/22	4/23	4/24	4/25
Michigan	857,774	867,624	873,700	873,700	882,246	891,066	900,041	909,050	917,906	926,995	936,328

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:						
	4/15	4/16	4/17	4/18	4/19	4/20	4/21	4/22	4/23	4/24	4/25
Genesee	35,662	36,248	36,499	36,499	36,946	37,409	37,873	38,340	38,828	39,316	39,816
Ingham	22,097	22,304	22,408	22,408	22,580	22,753	22,928	23,104	23,279	23,450	23,625
Kent	62,643	63,296	63,710	63,710	64,226	64,736	65,260	65,800	66,364	66,919	67,483
Livingston	14,418	14,573	14,653	14,653	14,814	14,978	15,146	15,321	15,495	15,672	15,855
Macomb	85,995	87,028	87,780	87,780	88,583	89,389	90,196	90,994	91,764	92,545	93,308
Monroe	13,420	13,566	13,620	13,620	13,750	13,878	14,009	14,145	14,279	14,415	14,553
Oakland	101,670	102,866	103,724	103,724	104,746	105,773	106,813	107,861	108,927	109,996	111,086
Washtenaw	23,763	24,001	24,138	24,138	24,369	24,599	24,833	25,073	25,323	25,575	25,831
Wayne	140,324	142,075	143,217	143,217	144,842	146,463	148,183	149,934	151,617	153,384	155,197

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:		
	4/15	4/16	4/17	4/18	4/20	4/22	4/24
Genesee	35,662	36,248	36,499	36,499	37,409 (7,482) [1,796] {898}	38,340 (7,668) [1,840] {920}	39,316 (7,863) [1,887] {944}
Ingham	22,097	22,304	22,408	22,408	22,753 (4,551) [1,092] {546}	23,104 (4,621) [1,109] {554}	23,450 (4,690) [1,126] {563}
Kent	62,643	63,296	63,710	63,710	64,736 (12,947) [3,107] {1,554}	65,800 (13,160) [3,158] {1,579}	66,919 (13,384) [3,212] {1,606}
Livingston	14,418	14,573	14,653	14,653	14,978 (2,996) [719] {359}	15,321 (3,064) [735] {368}	15,672 (3,134) [752] {376}
Macomb	85,995	87,028	87,780	87,780	89,389 (17,878) [4,291] {2,145}	90,994 (18,199) [4,368] {2,184}	92,545 (18,509) [4,442] {2,221}
Monroe	13,420	13,566	13,620	13,620	13,878 (2,776) [666] {333}	14,145 (2,829) [679] {339}	14,415 (2,883) [692] {346}
Oakland	101,670	102,866	103,724	103,724	105,773 (21,155) [5,077] {2,539}	107,861 (21,572) [5,177] {2,589}	109,996 (21,999) [5,280] {2,640}
Washtenaw	23,763	24,001	24,138	24,138	24,599 (4,920) [1,181] {590}	25,073 (5,015) [1,204] {602}	25,575 (5,115) [1,228] {614}
Wayne	140,324	142,075	143,217	143,217	146,463 (29,293) [7,030] {3,515}	149,934 (29,987) [7,197] {3,598}	153,384 (30,677) [7,362] {3,681}

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.