IEM's AI Modeling: Short-term COVID-19 Projections
Date: 3/23/21

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 3/23/21 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
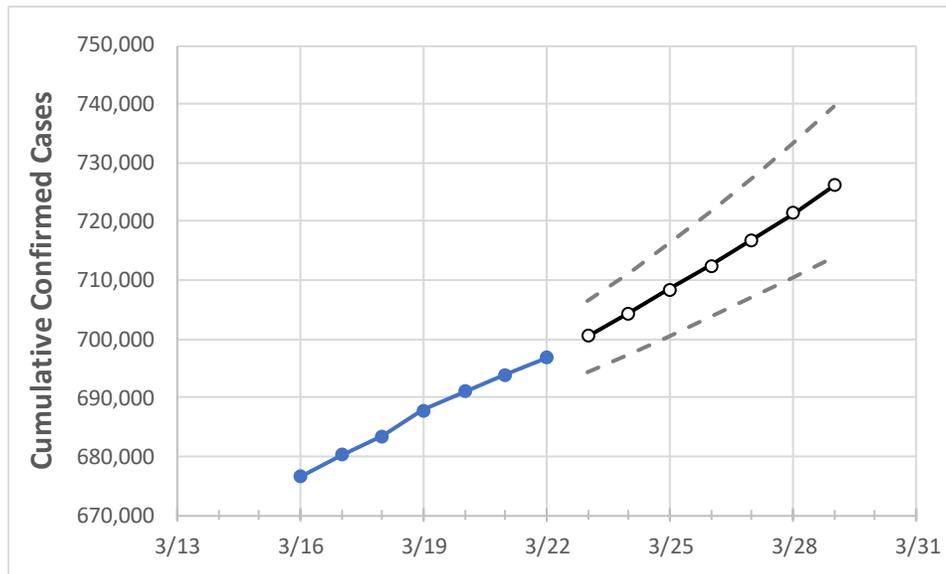
	Actual Confirmed Cases On:				Projected Cases For:						
	3/19	3/20	3/21	3/22	3/23	3/24	3/25	3/26	3/27	3/28	3/29
Michigan	687,815	691,070	693,954	696,838	700,524	704,355	708,363	712,478	716,851	721,424	726,182

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:						
	3/19	3/20	3/21	3/22	3/23	3/24	3/25	3/26	3/27	3/28	3/29
Genesee	27,628	27,796	27,916	28,035	28,209	28,387	28,574	28,767	28,970	29,183	29,402
Ingham	17,666	17,764	17,870	17,975	18,097	18,221	18,355	18,493	18,640	18,793	18,955
Kent	53,738	53,878	54,012	54,146	54,297	54,447	54,604	54,765	54,932	55,101	55,272
Livingston	11,174	11,228	11,295	11,362	11,436	11,513	11,595	11,681	11,769	11,859	11,953
Macomb	64,079	64,525	64,922	65,318	65,836	66,373	66,936	67,539	68,179	68,858	69,572
Monroe	10,651	10,716	10,753	10,790	10,850	10,912	10,975	11,040	11,106	11,174	11,244
Oakland	79,999	80,481	80,908	81,335	81,887	82,466	83,085	83,740	84,434	85,161	85,951
Washtenaw	19,604	19,654	19,715	19,776	19,836	19,898	19,959	20,021	20,085	20,150	20,216
Wayne	108,743	109,236	109,805	110,373	110,999	111,653	112,346	113,066	113,832	114,640	115,460

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:		
	3/19	3/20	3/21	3/22	3/24	3/26	3/28
Genesee	27,628	27,796	27,916	28,035	28,387 (5,677) [1,363] {681}	28,767 (5,753) [1,381] {690}	29,183 (5,837) [1,401] {700}
Ingham	17,666	17,764	17,870	17,975	18,221 (3,644) [875] {437}	18,493 (3,699) [888] {444}	18,793 (3,759) [902] {451}
Kent	53,738	53,878	54,012	54,146	54,447 (10,889) [2,613] {1,307}	54,765 (10,953) [2,629] {1,314}	55,101 (11,020) [2,645] {1,322}
Livingston	11,174	11,228	11,295	11,362	11,513 (2,303) [553] {276}	11,681 (2,336) [561] {280}	11,859 (2,372) [569] {285}
Macomb	64,079	64,525	64,922	65,318	66,373 (13,275) [3,186] {1,593}	67,539 (13,508) [3,242] {1,621}	68,858 (13,772) [3,305] {1,653}
Monroe	10,651	10,716	10,753	10,790	10,912 (2,182) [524] {262}	11,040 (2,208) [530] {265}	11,174 (2,235) [536] {268}
Oakland	79,999	80,481	80,908	81,335	82,466 (16,493) [3,958] {1,979}	83,740 (16,748) [4,020] {2,010}	85,161 (17,032) [4,088] {2,044}
Washtenaw	19,604	19,654	19,715	19,776	19,898 (3,980) [955] {478}	20,021 (4,004) [961] {481}	20,150 (4,030) [967] {484}
Wayne	108,743	109,236	109,805	110,373	111,653 (22,331) [5,359] {2,680}	113,066 (22,613) [5,427] {2,714}	114,640 (22,928) [5,503] {2,751}

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.