IEM's AI Modeling: Short-term COVID-19 Projections
Date: 2/19/21

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 2/19/21 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
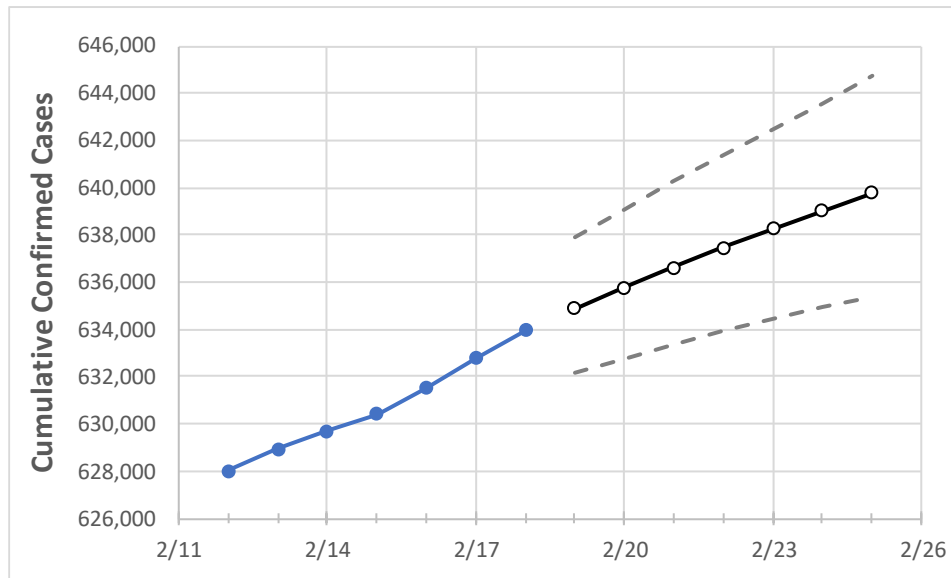
	Actual Confirmed Cases On:				Projected Cases For:						
	2/15	2/16	2/17	2/18	2/19	2/20	2/21	2/22	2/23	2/24	2/25
Michigan	630,408	631,532	632,772	633,973	634,885	635,772	636,631	637,449	638,256	639,034	639,803

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:						
	2/15	2/16	2/17	2/18	2/19	2/20	2/21	2/22	2/23	2/24	2/25
Genesee	24,941	24,975	25,000	25,055	25,084	25,113	25,140	25,168	25,194	25,220	25,245
Ingham	15,883	15,935	15,999	16,037	16,077	16,115	16,152	16,188	16,224	16,259	16,292
Kent	50,730	50,808	50,903	50,983	51,056	51,127	51,198	51,268	51,337	51,404	51,467
Livingston	10,017	10,037	10,055	10,068	10,081	10,093	10,105	10,116	10,127	10,137	10,147
Macomb	57,496	57,577	57,680	57,785	57,859	57,931	57,999	58,065	58,130	58,194	58,258
Monroe	9,516	9,533	9,561	9,567	9,580	9,593	9,606	9,617	9,629	9,640	9,650
Oakland	72,987	73,116	73,290	73,470	73,587	73,701	73,815	73,922	74,028	74,131	74,230
Washtenaw	17,982	18,016	18,064	18,140	18,197	18,252	18,307	18,357	18,407	18,456	18,506
Wayne	99,515	99,697	99,850	100,033	100,163	100,290	100,413	100,532	100,647	100,761	100,872

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:		
	2/15	2/16	2/17	2/18	2/20	2/22	2/24
Genesee	24,941	24,975	25,000	25,055	25,113 (5,023) [1,205] {603}	25,168 (5,034) [1,208] {604}	25,220 (5,044) [1,211] {605}
Ingham	15,883	15,935	15,999	16,037	16,115 (3,223) [774] {387}	16,188 (3,238) [777] {389}	16,259 (3,252) [780] {390}
Kent	50,730	50,808	50,903	50,983	51,127 (10,225) [2,454] {1,227}	51,268 (10,254) [2,461] {1,230}	51,404 (10,281) [2,467] {1,234}
Livingston	10,017	10,037	10,055	10,068	10,093 (2,019) [484] {242}	10,116 (2,023) [486] {243}	10,137 (2,027) [487] {243}
Macomb	57,496	57,577	57,680	57,785	57,931 (11,586) [2,781] {1,390}	58,065 (11,613) [2,787] {1,394}	58,194 (11,639) [2,793] {1,397}
Monroe	9,516	9,533	9,561	9,567	9,593 (1,919) [460] {230}	9,617 (1,923) [462] {231}	9,640 (1,928) [463] {231}
Oakland	72,987	73,116	73,290	73,470	73,701 (14,740) [3,538] {1,769}	73,922 (14,784) [3,548] {1,774}	74,131 (14,826) [3,558] {1,779}
Washtenaw	17,982	18,016	18,064	18,140	18,252 (3,650) [876] {438}	18,357 (3,671) [881] {441}	18,456 (3,691) [886] {443}
Wayne	99,515	99,697	99,850	100,033	100,290 (20,058) [4,814] {2,407}	100,532 (20,106) [4,826] {2,413}	100,761 (20,152) [4,837] {2,418}

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.