IEM's AI Modeling: Short-term COVID-19 Projections

Date: 4/7/21

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 4/7/21 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.

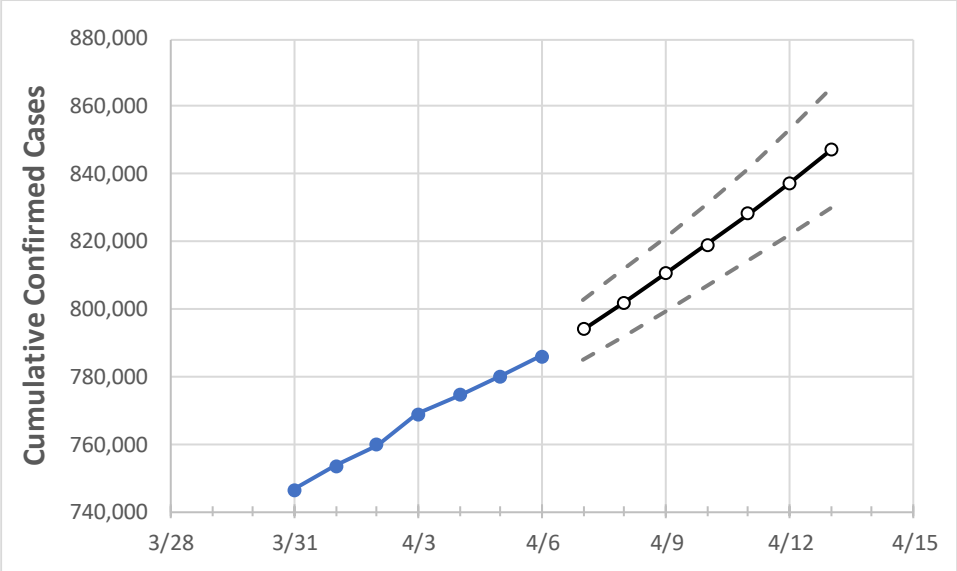
IEM's Modeling Lead

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:						
	4/3	4/4	4/5	4/6	4/7	4/8	4/9	4/10	4/11	4/12	4/13
Michigan	768,892	774,433	779,974	786,123	793,842	802,015	810,378	819,062	828,097	837,465	847,039

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:						
	4/3	4/4	4/5	4/6	4/7	4/8	4/9	4/10	4/11	4/12	4/13
Genesee	31,410	31,649	31,888	32,130	32,494	32,868	33,264	33,668	34,096	34,537	34,994
Ingham	20,036	20,194	20,352	20,471	20,680	20,898	21,120	21,349	21,587	21,831	22,080
Kent	57,741	58,019	58,297	58,601	59,022	59,467	59,934	60,425	60,931	61,464	62,040
Livingston	12,631	12,747	12,863	12,949	13,075	13,203	13,333	13,466	13,601	13,741	13,883
Macomb	75,793	76,537	77,281	77,991	79,065	80,184	81,331	82,512	83,735	84,990	86,280
Monroe	12,013	12,097	12,180	12,272	12,401	12,534	12,675	12,817	12,968	13,118	13,274
Oakland	90,618	91,436	92,253	93,013	94,001	95,029	96,070	97,156	98,272	99,420	100,619
Washtenaw	21,439	21,548	21,657	21,871	22,065	22,268	22,481	22,704	22,939	23,193	23,456
Wayne	122,971	124,168	125,364	126,530	128,031	129,608	131,281	133,000	134,788	136,679	138,630

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:		
	4/3	4/4	4/5	4/6	4/8	4/10	4/12
Genesee	31,410	31,649	31,888	32,130	32,868 (6,574) [1,578] {789}	33,668 (6,734) [1,616] {808}	34,537 (6,907) [1,658] {829}
Ingham	20,036	20,194	20,352	20,471	20,898 (4,180) [1,003] {502}	21,349 (4,270) [1,025] {512}	21,831 (4,366) [1,048] {524}
Kent	57,741	58,019	58,297	58,601	59,467 (11,893) [2,854] {1,427}	60,425 (12,085) [2,900] {1,450}	61,464 (12,293) [2,950] {1,475}
Livingston	12,631	12,747	12,863	12,949	13,203 (2,641) [634] {317}	13,466 (2,693) [646] {323}	13,741 (2,748) [660] {330}
Macomb	75,793	76,537	77,281	77,991	80,184 (16,037) [3,849] {1,924}	82,512 (16,502) [3,961] {1,980}	84,990 (16,998) [4,080] {2,040}
Monroe	12,013	12,097	12,180	12,272	12,534 (2,507) [602] {301}	12,817 (2,563) [615] {308}	13,118 (2,624) [630] {315}
Oakland	90,618	91,436	92,253	93,013	95,029 (19,006) [4,561] {2,281}	97,156 (19,431) [4,664] {2,332}	99,420 (19,884) [4,772] {2,386}
Washtenaw	21,439	21,548	21,657	21,871	22,268 (4,454) [1,069] {534}	22,704 (4,541) [1,090] {545}	23,193 (4,639) [1,113] {557}
Wayne	122,971	124,168	125,364	126,530	129,608 (25,922) [6,221] {3,111}	133,000 (26,600) [6,384] {3,192}	136,679 (27,336) [6,561] {3,280}

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.