IEM's AI Modeling: Short-term COVID-19 Projections
Date: 1/14/22

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 1/14/22 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
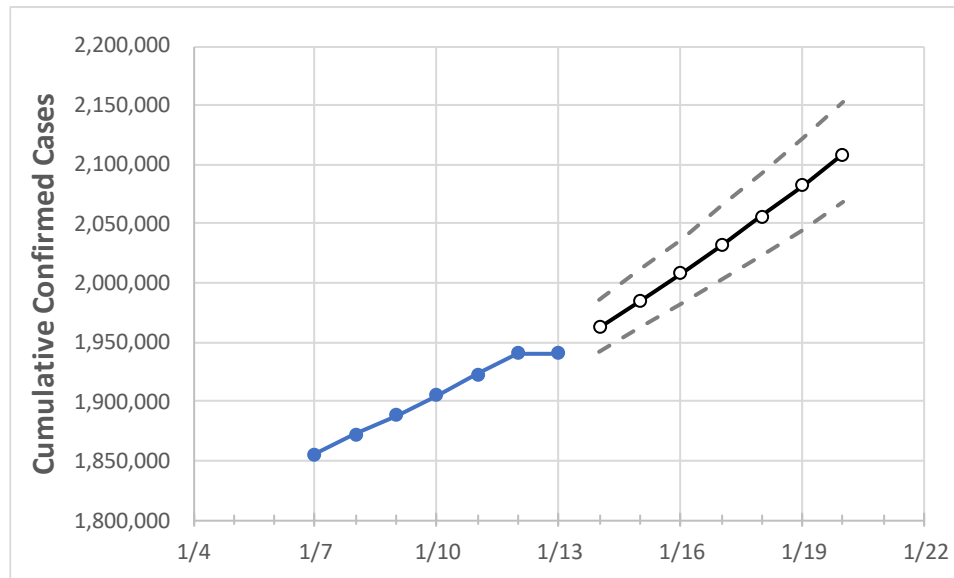
	Actual Confirmed Cases On:				Projected Cases For:						
	1/10	1/11	1/12	1/13	1/14	1/15	1/16	1/17	1/18	1/19	1/20
Michigan	1,904,949	1,922,829	1,940,708	1,940,708	1,962,592	1,984,911	2,008,255	2,031,897	2,056,532	2,082,246	2,108,554

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:						
	1/10	1/11	1/12	1/13	1/14	1/15	1/16	1/17	1/18	1/19	1/20
Genesee	81,052	81,846	82,639	82,639	83,727	84,810	86,004	87,166	88,440	89,712	91,071
Ingham	47,947	48,694	49,440	49,440	50,254	51,111	52,009	52,951	53,940	54,968	56,053
Kent	135,681	136,931	138,180	138,180	139,639	141,147	142,666	144,278	145,917	147,649	149,428
Livingston	36,633	36,976	37,319	37,319	37,726	38,142	38,578	39,022	39,485	39,976	40,457
Macomb	187,123	188,443	189,762	189,762	191,898	194,083	196,277	198,483	200,879	203,230	205,660
Monroe	30,802	31,132	31,462	31,462	31,913	32,383	32,874	33,394	33,922	34,474	35,059
Oakland	228,069	230,243	232,417	232,417	235,415	238,477	241,630	244,953	248,257	251,670	255,215
Washtenaw	55,368	56,191	57,014	57,014	58,145	59,330	60,565	61,841	63,200	64,580	66,040
Wayne	319,731	322,579	325,426	325,426	329,115	332,819	336,480	340,259	344,062	347,908	351,725

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:		
	1/10	1/11	1/12	1/13	1/15	1/17	1/19
Genesee	81,052	81,846	82,639	82,639	84,810 (16,962) [4,071] {2,035}	87,166 (17,433) [4,184] {2,092}	89,712 (17,942) [4,306] {2,153}
Ingham	47,947	48,694	49,440	49,440	51,111 (10,222) [2,453] {1,227}	52,951 (10,590) [2,542] {1,271}	54,968 (10,994) [2,638] {1,319}
Kent	135,681	136,931	138,180	138,180	141,147 (28,229) [6,775] {3,388}	144,278 (28,856) [6,925] {3,463}	147,649 (29,530) [7,087] {3,544}
Livingston	36,633	36,976	37,319	37,319	38,142 (7,628) [1,831] {915}	39,022 (7,804) [1,873] {937}	39,976 (7,995) [1,919] {959}
Macomb	187,123	188,443	189,762	189,762	194,083 (38,817) [9,316] {4,658}	198,483 (39,697) [9,527] {4,764}	203,230 (40,646) [9,755] {4,878}
Monroe	30,802	31,132	31,462	31,462	32,383 (6,477) [1,554] {777}	33,394 (6,679) [1,603] {801}	34,474 (6,895) [1,655] {827}
Oakland	228,069	230,243	232,417	232,417	238,477 (47,695) [11,447] {5,723}	244,953 (48,991) [11,758] {5,879}	251,670 (50,334) [12,080] {6,040}
Washtenaw	55,368	56,191	57,014	57,014	59,330 (11,866) [2,848] {1,424}	61,841 (12,368) [2,968] {1,484}	64,580 (12,916) [3,100] {1,550}
Wayne	319,731	322,579	325,426	325,426	332,819 (66,564) [15,975] {7,988}	340,259 (68,052) [16,332] {8,166}	347,908 (69,582) [16,700] {8,350}

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.