IEM's AI Modeling: Short-term COVID-19 Projections
Date: 4/9/21

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 4/9/21 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.

Ohio State Projections
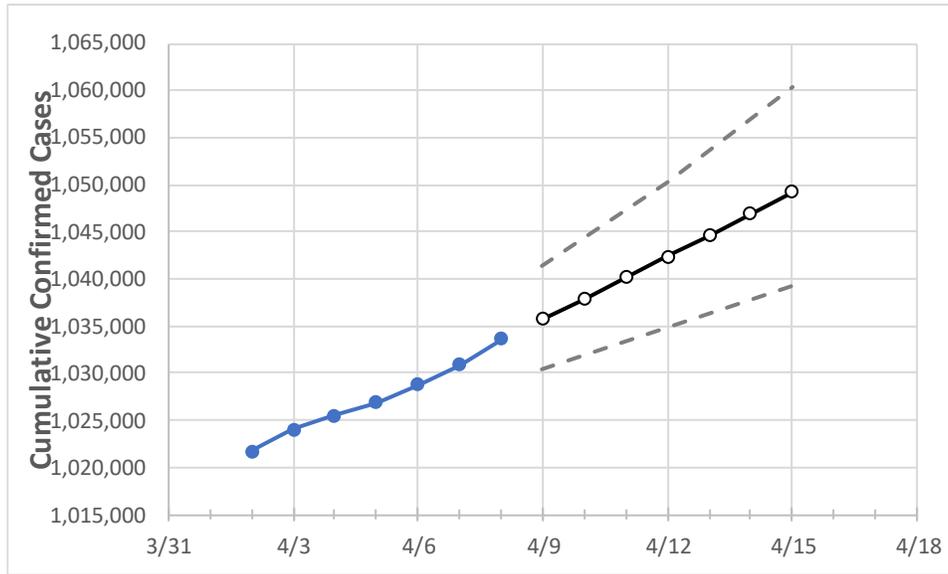
	Actual Confirmed Cases On:				Projected Cases For:						
	4/5	4/6	4/7	4/8	4/9	4/10	4/11	4/12	4/13	4/14	4/15
Ohio	1,026,929	1,028,800	1,030,864	1,033,606	1,035,748	1,037,901	1,040,126	1,042,342	1,044,638	1,046,951	1,049,291

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.

Ohio Counties

	Actual Confirmed Cases On:				Projected Cases For:						
	4/5	4/6	4/7	4/8	4/9	4/10	4/11	4/12	4/13	4/14	4/15
Athens	4,874	4,887	4,896	4,911	4,922	4,934	4,946	4,959	4,972	4,985	4,999
Cuyahoga	103,289	103,578	103,902	104,290	104,606	104,930	105,264	105,607	105,957	106,314	106,678
Franklin	119,040	119,303	119,541	119,897	120,185	120,479	120,773	121,080	121,388	121,712	122,037
Hamilton	76,896	76,986	77,090	77,213	77,312	77,413	77,516	77,617	77,721	77,823	77,923
Lake	19,438	19,494	19,537	19,603	19,657	19,713	19,773	19,834	19,898	19,966	20,036
Lorain	23,465	23,511	23,566	23,670	23,730	23,792	23,855	23,921	23,987	24,054	24,122
Lucas	38,460	38,545	38,669	38,790	38,912	39,035	39,158	39,284	39,410	39,540	39,669
Mahoning	20,421	20,463	20,513	20,543	20,585	20,630	20,674	20,720	20,766	20,814	20,864
Medina	14,506	14,525	14,551	14,601	14,631	14,662	14,693	14,724	14,754	14,784	14,815
Miami	10,386	10,394	10,407	10,426	10,437	10,448	10,458	10,469	10,480	10,491	10,502
Summit	43,868	43,976	44,078	44,226	44,357	44,486	44,617	44,751	44,885	45,020	45,160

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.*

Ohio Medical Demands by County

	Actual Confirmed Cases On:				Projected Cases (Hospitalized) [ICU] {Ventilator} For:		
	4/5	4/6	4/7	4/8	4/10	4/12	4/14
Athens	4,874	4,887	4,896	4,911	4,934 (987) [237] {118}	4,959 (992) [238] {119}	4,985 (997) [239] {120}
Cuyahoga	103,289	103,578	103,902	104,290	104,930 (20,986) [5,037] {2,518}	105,607 (21,121) [5,069] {2,535}	106,314 (21,263) [5,103] {2,552}
Franklin	119,040	119,303	119,541	119,897	120,479 (24,096) [5,783] {2,891}	121,080 (24,216) [5,812] {2,906}	121,712 (24,342) [5,842] {2,921}
Hamilton	76,896	76,986	77,090	77,213	77,413 (15,483) [3,716] {1,858}	77,617 (15,523) [3,726] {1,863}	77,823 (15,565) [3,735] {1,868}
Lake	19,438	19,494	19,537	19,603	19,713 (3,943) [946] {473}	19,834 (3,967) [952] {476}	19,966 (3,993) [958] {479}
Lorain	23,465	23,511	23,566	23,670	23,792 (4,758) [1,142] {571}	23,921 (4,784) [1,148] {574}	24,054 (4,811) [1,155] {577}
Lucas	38,460	38,545	38,669	38,790	39,035 (7,807) [1,874] {937}	39,284 (7,857) [1,886] {943}	39,540 (7,908) [1,898] {949}
Mahoning	20,421	20,463	20,513	20,543	20,630 (4,126) [990] {495}	20,720 (4,144) [995] {497}	20,814 (4,163) [999] {500}
Medina	14,506	14,525	14,551	14,601	14,662 (2,932) [704] {352}	14,724 (2,945) [707] {353}	14,784 (2,957) [710] {355}
Miami	10,386	10,394	10,407	10,426	10,448 (2,090) [501] {251}	10,469 (2,094) [503] {251}	10,491 (2,098) [504] {252}
Summit	43,868	43,976	44,078	44,226	44,486 (8,897) [2,135] {1,068}	44,751 (8,950) [2,148] {1,074}	45,020 (9,004) [2,161] {1,080}

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.