IEM's AI Modeling: Short-term COVID-19 Projections
Date: 5/4/21

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 5/4/21 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
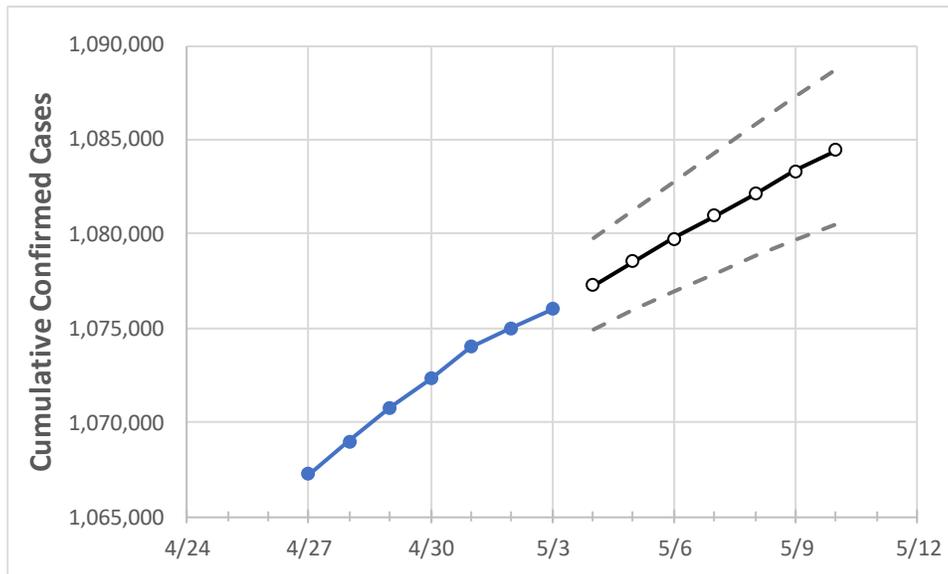
	Actual Confirmed Cases On:				Projected Cases For:						
	4/30	5/1	5/2	5/3	5/4	5/5	5/6	5/7	5/8	5/9	5/10
Ohio	1,072,312	1,074,019	1,075,004	1,075,999	1,077,283	1,078,538	1,079,768	1,080,943	1,082,117	1,083,313	1,084,454

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:						
	4/30	5/1	5/2	5/3	5/4	5/5	5/6	5/7	5/8	5/9	5/10
Athens	5,156	5,163	5,167	5,169	5,176	5,183	5,189	5,195	5,202	5,208	5,214
Cuyahoga	110,285	110,568	110,740	110,922	111,146	111,364	111,580	111,789	111,996	112,205	112,412
Franklin	124,615	124,806	124,919	125,028	125,170	125,309	125,449	125,581	125,711	125,839	125,959
Hamilton	79,413	79,492	79,544	79,577	79,658	79,737	79,816	79,893	79,970	80,047	80,122
Lake	20,411	20,447	20,473	20,492	20,518	20,542	20,567	20,591	20,614	20,637	20,659
Lorain	24,685	24,723	24,757	24,790	24,821	24,852	24,882	24,912	24,941	24,970	24,997
Lucas	41,471	41,582	41,645	41,714	41,801	41,886	41,969	42,051	42,133	42,212	42,290
Mahoning	21,276	21,315	21,353	21,378	21,407	21,435	21,464	21,493	21,521	21,550	21,578
Medina	15,137	15,161	15,170	15,181	15,196	15,211	15,225	15,239	15,253	15,266	15,280
Miami	10,629	10,637	10,638	10,646	10,652	10,657	10,662	10,667	10,672	10,677	10,681
Summit	46,527	46,637	46,703	46,774	46,849	46,921	46,993	47,064	47,136	47,204	47,272

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:		
	4/30	5/1	5/2	5/3	5/5	5/7	5/9
Athens	5,156	5,163	5,167	5,169	5,183 (1,037) [249] {124}	5,195 (1,039) [249] {125}	5,208 (1,042) [250] {125}
Cuyahoga	110,285	110,568	110,740	110,922	111,364 (22,273) [5,345] {2,673}	111,789 (22,358) [5,366] {2,683}	112,205 (22,441) [5,386] {2,693}
Franklin	124,615	124,806	124,919	125,028	125,309 (25,062) [6,015] {3,007}	125,581 (25,116) [6,028] {3,014}	125,839 (25,168) [6,040] {3,020}
Hamilton	79,413	79,492	79,544	79,577	79,737 (15,947) [3,827] {1,914}	79,893 (15,979) [3,835] {1,917}	80,047 (16,009) [3,842] {1,921}
Lake	20,411	20,447	20,473	20,492	20,542 (4,108) [986] {493}	20,591 (4,118) [988] {494}	20,637 (4,127) [991] {495}
Lorain	24,685	24,723	24,757	24,790	24,852 (4,970) [1,193] {596}	24,912 (4,982) [1,196] {598}	24,970 (4,994) [1,199] {599}
Lucas	41,471	41,582	41,645	41,714	41,886 (8,377) [2,011] {1,005}	42,051 (8,410) [2,018] {1,009}	42,212 (8,442) [2,026] {1,013}
Mahoning	21,276	21,315	21,353	21,378	21,435 (4,287) [1,029] {514}	21,493 (4,299) [1,032] {516}	21,550 (4,310) [1,034] {517}
Medina	15,137	15,161	15,170	15,181	15,211 (3,042) [730] {365}	15,239 (3,048) [731] {366}	15,266 (3,053) [733] {366}
Miami	10,629	10,637	10,638	10,646	10,657 (2,131) [512] {256}	10,667 (2,133) [512] {256}	10,677 (2,135) [512] {256}
Summit	46,527	46,637	46,703	46,774	46,921 (9,384) [2,252] {1,126}	47,064 (9,413) [2,259] {1,130}	47,204 (9,441) [2,266] {1,133}

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.