IEM's AI Modeling: Short-term COVID-19 Projections
Date: 4/6/21

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 4/6/21 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
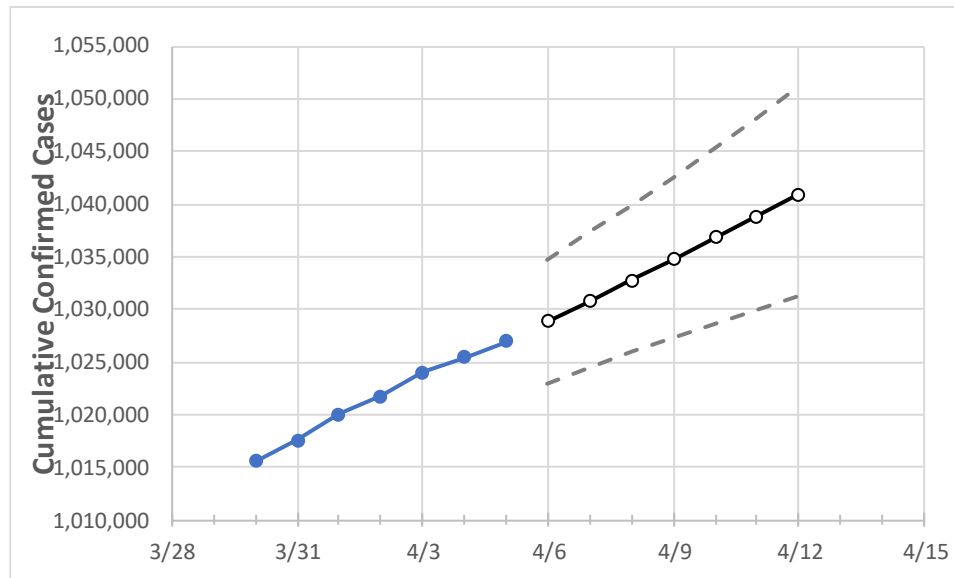
	Actual Confirmed Cases On:				Projected Cases For:						
	4/2	4/3	4/4	4/5	4/6	4/7	4/8	4/9	4/10	4/11	4/12
Ohio	1,021,718	1,024,011	1,025,470	1,026,929	1,028,842	1,030,780	1,032,745	1,034,736	1,036,793	1,038,858	1,040,894

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:						
	4/2	4/3	4/4	4/5	4/6	4/7	4/8	4/9	4/10	4/11	4/12
Athens	4,852	4,863	4,869	4,874	4,883	4,892	4,901	4,910	4,920	4,929	4,939
Cuyahoga	102,539	102,868	103,079	103,289	103,555	103,827	104,100	104,376	104,658	104,947	105,228
Franklin	118,366	118,657	118,849	119,040	119,296	119,558	119,822	120,086	120,359	120,636	120,907
Hamilton	76,620	76,740	76,818	76,896	76,997	77,098	77,201	77,301	77,403	77,504	77,608
Lake	19,322	19,370	19,404	19,438	19,476	19,514	19,553	19,593	19,634	19,675	19,717
Lorain	23,338	23,400	23,433	23,465	23,519	23,573	23,628	23,684	23,740	23,798	23,858
Lucas	38,171	38,282	38,371	38,460	38,584	38,711	38,842	38,974	39,104	39,238	39,375
Mahoning	20,317	20,372	20,397	20,421	20,461	20,501	20,542	20,585	20,627	20,672	20,717
Medina	14,418	14,464	14,485	14,506	14,536	14,565	14,595	14,626	14,656	14,686	14,716
Miami	10,355	10,373	10,380	10,386	10,397	10,408	10,419	10,430	10,441	10,453	10,463
Summit	43,507	43,639	43,754	43,868	43,998	44,131	44,269	44,404	44,543	44,683	44,828

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:		
	4/2	4/3	4/4	4/5	4/7	4/9	4/11
Athens	4,852	4,863	4,869	4,874	4,892 (978) [235] {117}	4,910 (982) [236] {118}	4,929 (986) [237] {118}
Cuyahoga	102,539	102,868	103,079	103,289	103,827 (20,765) [4,984] {2,492}	104,376 (20,875) [5,010] {2,505}	104,947 (20,989) [5,037] {2,519}
Franklin	118,366	118,657	118,849	119,040	119,558 (23,912) [5,739] {2,869}	120,086 (24,017) [5,764] {2,882}	120,636 (24,127) [5,791] {2,895}
Hamilton	76,620	76,740	76,818	76,896	77,098 (15,420) [3,701] {1,850}	77,301 (15,460) [3,710] {1,855}	77,504 (15,501) [3,720] {1,860}
Lake	19,322	19,370	19,404	19,438	19,514 (3,903) [937] {468}	19,593 (3,919) [940] {470}	19,675 (3,935) [944] {472}
Lorain	23,338	23,400	23,433	23,465	23,573 (4,715) [1,132] {566}	23,684 (4,737) [1,137] {568}	23,798 (4,760) [1,142] {571}
Lucas	38,171	38,282	38,371	38,460	38,711 (7,742) [1,858] {929}	38,974 (7,795) [1,871] {935}	39,238 (7,848) [1,883] {942}
Mahoning	20,317	20,372	20,397	20,421	20,501 (4,100) [984] {492}	20,585 (4,117) [988] {494}	20,672 (4,134) [992] {496}
Medina	14,418	14,464	14,485	14,506	14,565 (2,913) [699] {350}	14,626 (2,925) [702] {351}	14,686 (2,937) [705] {352}
Miami	10,355	10,373	10,380	10,386	10,408 (2,082) [500] {250}	10,430 (2,086) [501] {250}	10,453 (2,091) [502] {251}
Summit	43,507	43,639	43,754	43,868	44,131 (8,826) [2,118] {1,059}	44,404 (8,881) [2,131] {1,066}	44,683 (8,937) [2,145] {1,072}

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.