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

Date: 12/21/20

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 12/21/20 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.

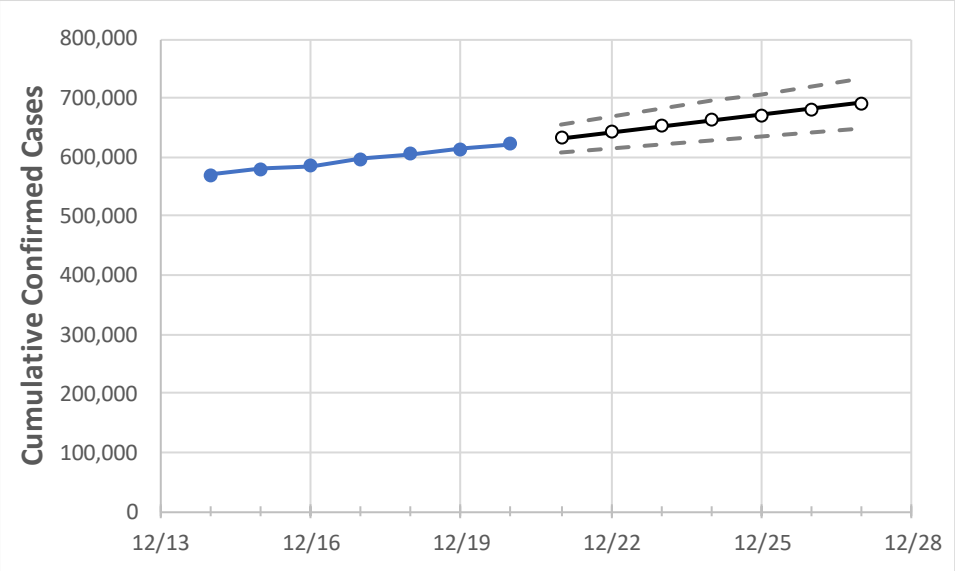
IEM's Modeling Lead

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:						
	12/17	12/18	12/19	12/20	12/21	12/22	12/23	12/24	12/25	12/26	12/27
Ohio	596,178	605,862	614,429	622,806	632,718	642,580	652,394	662,159	671,875	681,542	691,159

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 20%, and are often within 10%, of actual confirmed cases.

Ohio Counties

	Actual Confirmed Cases On:				Projected Cases For:						
	12/17	12/18	12/19	12/20	12/21	12/22	12/23	12/24	12/25	12/26	12/27
Athens	2,731	2,775	2,797	2,826	2,857	2,887	2,917	2,946	2,975	3,003	3,031
Cuyahoga	59,363	60,299	61,201	62,366	63,422	64,478	65,532	66,585	67,637	68,687	69,736
Franklin	72,583	73,651	74,477	75,316	76,311	77,295	78,268	79,231	80,184	81,127	82,059
Hamilton	45,052	45,723	46,283	46,842	47,493	48,138	48,778	49,412	50,042	50,665	51,284
Lake	10,743	10,899	11,034	11,200	11,355	11,509	11,662	11,814	11,964	12,113	12,261
Lorain	12,162	12,438	12,672	12,905	13,152	13,396	13,637	13,875	14,111	14,343	14,573
Lucas	22,440	22,718	22,989	23,166	23,497	23,825	24,151	24,473	24,793	25,110	25,425
Mahoning	12,458	12,658	12,795	12,999	13,202	13,401	13,597	13,789	13,979	14,165	14,347
Medina	7,800	7,941	8,104	8,218	8,361	8,504	8,647	8,788	8,929	9,070	9,210
Miami	6,514	6,615	6,703	6,787	6,871	6,954	7,035	7,116	7,196	7,275	7,353
Summit	23,394	23,872	24,258	24,560	25,007	25,451	25,893	26,332	26,770	27,205	27,637

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:		
	12/17	12/18	12/19	12/20	12/22	12/24	12/26
Athens	2,731	2,775	2,797	2,826	2,887 (577) [139] {69}	2,946 (589) [141] {71}	3,003 (601) [144] {72}
Cuyahoga	59,363	60,299	61,201	62,366	64,478 (12,896) [3,095] {1,547}	66,585 (13,317) [3,196] {1,598}	68,687 (13,737) [3,297] {1,648}
Franklin	72,583	73,651	74,477	75,316	77,295 (15,459) [3,710] {1,855}	79,231 (15,846) [3,803] {1,902}	81,127 (16,225) [3,894] {1,947}
Hamilton	45,052	45,723	46,283	46,842	48,138 (9,628) [2,311] {1,155}	49,412 (9,882) [2,372] {1,186}	50,665 (10,133) [2,432] {1,216}
Lake	10,743	10,899	11,034	11,200	11,509 (2,302) [552] {276}	11,814 (2,363) [567] {284}	12,113 (2,423) [581] {291}
Lorain	12,162	12,438	12,672	12,905	13,396 (2,679) [643] {322}	13,875 (2,775) [666] {333}	14,343 (2,869) [688] {344}
Lucas	22,440	22,718	22,989	23,166	23,825 (4,765) [1,144] {572}	24,473 (4,895) [1,175] {587}	25,110 (5,022) [1,205] {603}
Mahoning	12,458	12,658	12,795	12,999	13,401 (2,680) [643] {322}	13,789 (2,758) [662] {331}	14,165 (2,833) [680] {340}
Medina	7,800	7,941	8,104	8,218	8,504 (1,701) [408] {204}	8,788 (1,758) [422] {211}	9,070 (1,814) [435] {218}
Miami	6,514	6,615	6,703	6,787	6,954 (1,391) [334] {167}	7,116 (1,423) [342] {171}	7,275 (1,455) [349] {175}
Summit	23,394	23,872	24,258	24,560	25,451 (5,090) [1,222] {611}	26,332 (5,266) [1,264] {632}	27,205 (5,441) [1,306] {653}

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.