IEM's AI Modeling: Short-term COVID-19 Projections
Date: 5/7/21

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 5/7/21 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.

New York State Projections
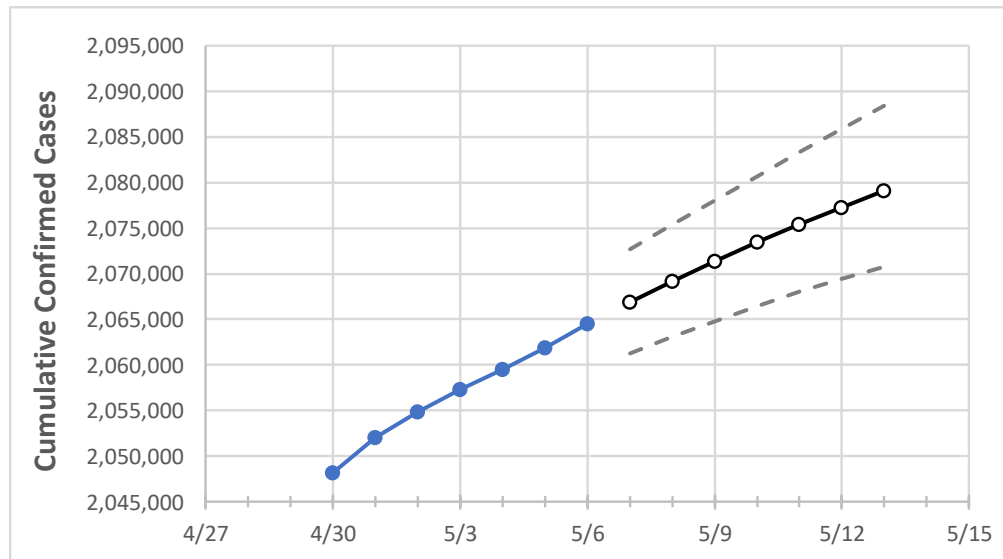
	Actual Confirmed Cases On:				Projected Cases For:						
	5/3	5/4	5/5	5/6	5/7	5/8	5/9	5/10	5/11	5/12	5/13
New York	2,057,276	2,059,485	2,061,887	2,064,530	2,066,878	2,069,184	2,071,342	2,073,442	2,075,393	2,077,287	2,079,098

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.

New York Counties

	Actual Confirmed Cases On:				Projected Cases For:						
	5/3	5/4	5/5	5/6	5/7	5/8	5/9	5/10	5/11	5/12	5/13
Albany	24,192	24,212	24,226	24,246	24,266	24,285	24,304	24,322	24,339	24,355	24,370
Bronx	179,370	179,527	179,752	179,949	180,136	180,308	180,483	180,647	180,802	180,959	181,103
Dutchess	28,781	28,816	28,850	28,892	28,928	28,963	28,997	29,030	29,062	29,091	29,120
Erie	86,742	86,897	87,017	87,153	87,314	87,466	87,617	87,760	87,897	88,027	88,153
Kings	273,833	274,114	274,464	274,812	275,158	275,498	275,815	276,125	276,411	276,692	276,957
Monroe	64,407	64,569	64,730	64,987	65,184	65,382	65,579	65,772	65,964	66,155	66,346
Nassau	180,860	180,992	181,108	181,253	181,376	181,496	181,605	181,709	181,808	181,900	181,986
New York	135,467	135,559	135,679	135,837	135,960	136,077	136,187	136,293	136,395	136,489	136,581
Niagara	19,228	19,270	19,306	19,347	19,391	19,433	19,475	19,516	19,554	19,591	19,627
Onondaga	37,359	37,416	37,457	37,518	37,591	37,666	37,741	37,812	37,882	37,953	38,021
Orange	47,349	47,390	47,437	47,491	47,540	47,584	47,628	47,669	47,708	47,746	47,781
Putnam	10,448	10,456	10,461	10,471	10,479	10,487	10,494	10,500	10,507	10,513	10,518
Queens	271,187	271,441	271,707	272,038	272,325	272,599	272,852	273,099	273,329	273,546	273,757
Rensselaer	10,952	10,957	10,964	10,977	10,987	10,997	11,006	11,015	11,023	11,032	11,039
Richmond	73,114	73,195	73,277	73,355	73,440	73,518	73,593	73,665	73,733	73,798	73,859
Rockland	46,362	46,388	46,446	46,483	46,509	46,534	46,559	46,582	46,604	46,626	46,646
Saratoga	14,833	14,863	14,887	14,903	14,922	14,942	14,960	14,978	14,995	15,013	15,028
Schenectady	12,754	12,778	12,800	12,815	12,834	12,852	12,870	12,888	12,906	12,923	12,939
Suffolk	197,718	197,866	198,023	198,183	198,343	198,490	198,629	198,764	198,893	199,015	199,130
Sullivan	6,419	6,425	6,438	6,456	6,467	6,477	6,487	6,497	6,506	6,514	6,522
Tompkins	4,160	4,169	4,178	4,184	4,190	4,196	4,202	4,208	4,214	4,220	4,226
Ulster	13,559	13,576	13,596	13,620	13,642	13,663	13,683	13,701	13,720	13,737	13,754
Westchester	127,975	128,066	128,153	128,236	128,319	128,397	128,472	128,544	128,612	128,676	128,738

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.*

New York Medical Demands by County

	Actual Confirmed Cases On:				Projected Cases (Hospitalized) [ICU] {Ventilator} For:		
	5/3	5/4	5/5	5/6	5/8	5/10	5/12
Albany	24,192	24,212	24,226	24,246	24,285 (4,857) [1,166] {583}	24,322 (4,864) [1,167] {584}	24,355 (4,871) [1,169] {585}
Bronx	179,370	179,527	179,752	179,949	180,308 (36,062) [8,655] {4,327}	180,647 (36,129) [8,671] {4,336}	180,959 (36,192) [8,686] {4,343}
Dutchess	28,781	28,816	28,850	28,892	28,963 (5,793) [1,390] {695}	29,030 (5,806) [1,393] {697}	29,091 (5,818) [1,396] {698}
Erie	86,742	86,897	87,017	87,153	87,466 (17,493) [4,198] {2,099}	87,760 (17,552) [4,212] {2,106}	88,027 (17,605) [4,225] {2,113}
Kings	273,833	274,114	274,464	274,812	275,498 (55,100) [13,224] {6,612}	276,125 (55,225) [13,254] {6,627}	276,692 (55,338) [13,281] {6,641}
Monroe	64,407	64,569	64,730	64,987	65,382 (13,076) [3,138] {1,569}	65,772 (13,154) [3,157] {1,579}	66,155 (13,231) [3,175] {1,588}
Nassau	180,860	180,992	181,108	181,253	181,496 (36,299) [8,712] {4,356}	181,709 (36,342) [8,722] {4,361}	181,900 (36,380) [8,731] {4,366}
New York	135,467	135,559	135,679	135,837	136,077 (27,215) [6,532] {3,266}	136,293 (27,259) [6,542] {3,271}	136,489 (27,298) [6,551] {3,276}
Niagara	19,228	19,270	19,306	19,347	19,433 (3,887) [933] {466}	19,516 (3,903) [937] {468}	19,591 (3,918) [940] {470}
Onondaga	37,359	37,416	37,457	37,518	37,666 (7,533) [1,808] {904}	37,812 (7,562) [1,815] {907}	37,953 (7,591) [1,822] {911}
Orange	47,349	47,390	47,437	47,491	47,584 (9,517) [2,284] {1,142}	47,669 (9,534) [2,288] {1,144}	47,746 (9,549) [2,292] {1,146}
Putnam	10,448	10,456	10,461	10,471	10,487 (2,097) [503] {252}	10,500 (2,100) [504] {252}	10,513 (2,103) [505] {252}
Queens	271,187	271,441	271,707	272,038	272,599 (54,520) [13,085] {6,542}	273,099 (54,620) [13,109] {6,554}	273,546 (54,709) [13,130] {6,565}
Rensselaer	10,952	10,957	10,964	10,977	10,997 (2,199) [528] {264}	11,015 (2,203) [529] {264}	11,032 (2,206) [530] {265}
Richmond	73,114	73,195	73,277	73,355	73,518 (14,704) [3,529] {1,764}	73,665 (14,733) [3,536] {1,768}	73,798 (14,760) [3,542] {1,771}
Rockland	46,362	46,388	46,446	46,483	46,534 (9,307) [2,234] {1,117}	46,582 (9,316) [2,236] {1,118}	46,626 (9,325) [2,238] {1,119}
Saratoga	14,833	14,863	14,887	14,903	14,942 (2,988) [717] {359}	14,978 (2,996) [719] {359}	15,013 (3,003) [721] {360}
Schenectady	12,754	12,778	12,800	12,815	12,852 (2,570) [617] {308}	12,888 (2,578) [619] {309}	12,923 (2,585) [620] {310}
Suffolk	197,718	197,866	198,023	198,183	198,490 (39,698) [9,528] {4,764}	198,764 (39,753) [9,541] {4,770}	199,015 (39,803) [9,553] {4,776}
Sullivan	6,419	6,425	6,438	6,456	6,477 (1,295) [311] {155}	6,497 (1,299) [312] {156}	6,514 (1,303) [313] {156}
Tompkins	4,160	4,169	4,178	4,184	4,196 (839) [201] {101}	4,208 (842) [202] {101}	4,220 (844) [203] {101}
Ulster	13,559	13,576	13,596	13,620	13,663 (2,733) [656] {328}	13,701 (2,740) [658] {329}	13,737 (2,747) [659] {330}
Westchester	127,975	128,066	128,153	128,236	128,397 (25,679) [6,163] {3,082}	128,544 (25,709) [6,170] {3,085}	128,676 (25,735) [6,176] {3,088}

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.