IEM's AI Modeling: Short-term COVID-19 Projections
Date: 7/16/20

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

The projections shown in this document are based on data pulled in as of 7/16/20 11 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
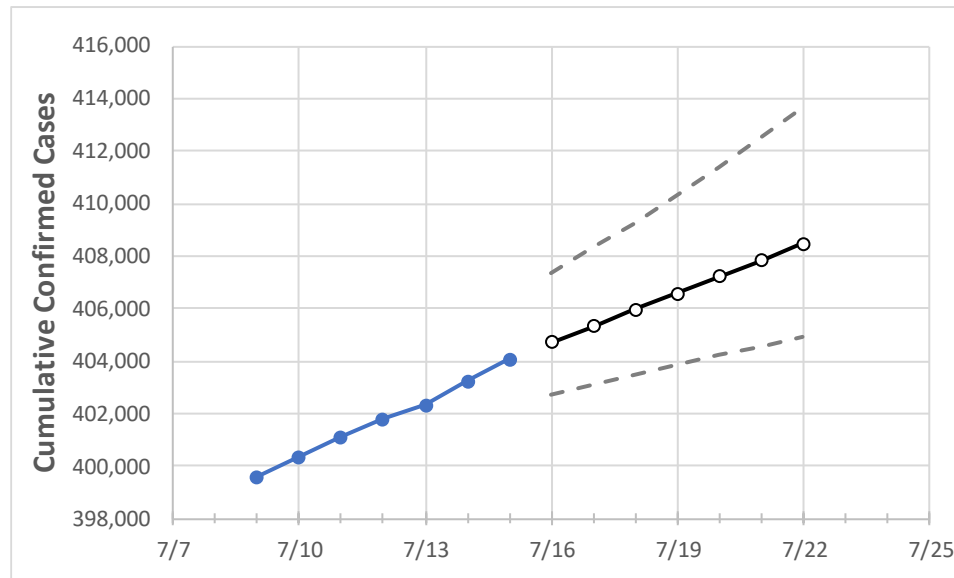
	Actual Confirmed Cases On:				Projected Cases For:						
	7/12	7/13	7/14	7/15	7/16	7/17	7/18	7/19	7/20	7/21	7/22
New York	401,775	402,332	403,244	404,075	404,699	405,324	405,951	406,579	407,208	407,839	408,470

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.

New York Counties

	Actual Confirmed Cases On:				Projected Cases For:						
	7/12	7/13	7/14	7/15	7/16	7/17	7/18	7/19	7/20	7/21	7/22
Albany	2,219	2,225	2,247	2,280	2,294	2,309	2,324	2,340	2,357	2,375	2,394
Bronx	48,327	48,377	48,433	48,496	48,546	48,595	48,644	48,692	48,740	48,787	48,833
Dutchess	4,276	4,280	4,318	4,337	4,344	4,351	4,358	4,365	4,373	4,380	4,387
Erie	7,742	7,766	7,833	7,891	7,933	7,976	8,019	8,064	8,109	8,155	8,203
Kings	60,748	60,815	60,904	61,012	61,093	61,173	61,252	61,331	61,410	61,487	61,564
Monroe	4,177	4,200	4,247	4,281	4,312	4,343	4,374	4,405	4,435	4,466	4,497
Nassau	42,307	42,354	42,423	42,462	42,507	42,553	42,600	42,647	42,695	42,743	42,792
New York	29,237	29,302	29,363	29,442	29,506	29,570	29,634	29,698	29,763	29,827	29,893
Niagara	1,340	1,342	1,351	1,356	1,363	1,370	1,377	1,383	1,390	1,397	1,405
Onondaga	3,124	3,142	3,179	3,203	3,229	3,256	3,284	3,312	3,341	3,370	3,401
Orange	10,835	10,841	10,850	10,878	10,887	10,896	10,905	10,914	10,923	10,932	10,941
Putnam	1,363	1,365	1,376	1,382	1,387	1,392	1,397	1,403	1,410	1,416	1,423
Queens	66,410	66,466	66,544	66,643	66,712	66,781	66,848	66,914	66,979	67,043	67,106
Rensselaer	616	617	625	632	638	645	652	660	669	678	687
Richmond	14,329	14,341	14,372	14,389	14,409	14,430	14,450	14,471	14,493	14,514	14,536
Rockland	13,716	13,719	13,733	13,743	13,751	13,759	13,766	13,773	13,781	13,788	13,795
Saratoga	602	610	616	623	631	638	645	652	659	666	673
Schenectady	864	868	883	891	896	901	907	912	918	923	929
Suffolk	42,028	42,112	42,214	42,267	42,336	42,407	42,480	42,554	42,631	42,709	42,790
Sullivan	1,465	1,466	1,466	1,467	1,468	1,468	1,469	1,470	1,470	1,471	1,471
Tompkins	186	190	194	198	201	203	207	211	215	221	227
Ulster	1,859	1,862	1,872	1,888	1,893	1,897	1,902	1,906	1,910	1,915	1,919
Westchester	35,297	35,327	35,366	35,394	35,425	35,455	35,485	35,515	35,544	35,573	35,601

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:		
	7/12	7/13	7/14	7/15	7/17	7/19	7/21
Albany	2,219	2,225	2,247	2,280	2,309 (462) [111] {55}	2,340 (468) [112] {56}	2,375 (475) [114] {57}
Bronx	48,327	48,377	48,433	48,496	48,595 (9,719) [2,333] {1,166}	48,692 (9,738) [2,337] {1,169}	48,787 (9,757) [2,342] {1,171}
Dutchess	4,276	4,280	4,318	4,337	4,351 (870) [209] {104}	4,365 (873) [210] {105}	4,380 (876) [210] {105}
Erie	7,742	7,766	7,833	7,891	7,976 (1,595) [383] {191}	8,064 (1,613) [387] {194}	8,155 (1,631) [391] {196}
Kings	60,748	60,815	60,904	61,012	61,173 (12,235) [2,936] {1,468}	61,331 (12,266) [2,944] {1,472}	61,487 (12,297) [2,951] {1,476}
Monroe	4,177	4,200	4,247	4,281	4,343 (869) [208] {104}	4,405 (881) [211] {106}	4,466 (893) [214] {107}
Nassau	42,307	42,354	42,423	42,462	42,553 (8,511) [2,043] {1,021}	42,647 (8,529) [2,047] {1,024}	42,743 (8,549) [2,052] {1,026}
New York	29,237	29,302	29,363	29,442	29,570 (5,914) [1,419] {710}	29,698 (5,940) [1,426] {713}	29,827 (5,965) [1,432] {716}
Niagara	1,340	1,342	1,351	1,356	1,370 (274) [66] {33}	1,383 (277) [66] {33}	1,397 (279) [67] {34}
Onondaga	3,124	3,142	3,179	3,203	3,256 (651) [156] {78}	3,312 (662) [159] {79}	3,370 (674) [162] {81}
Orange	10,835	10,841	10,850	10,878	10,896 (2,179) [523] {261}	10,914 (2,183) [524] {262}	10,932 (2,186) [525] {262}
Putnam	1,363	1,365	1,376	1,382	1,392 (278) [67] {33}	1,403 (281) [67] {34}	1,416 (283) [68] {34}
Queens	66,410	66,466	66,544	66,643	66,781 (13,356) [3,205] {1,603}	66,914 (13,383) [3,212] {1,606}	67,043 (13,409) [3,218] {1,609}
Rensselaer	616	617	625	632	645 (129) [31] {15}	660 (132) [32] {16}	678 (136) [33] {16}
Richmond	14,329	14,341	14,372	14,389	14,430 (2,886) [693] {346}	14,471 (2,894) [695] {347}	14,514 (2,903) [697] {348}
Rockland	13,716	13,719	13,733	13,743	13,759 (2,752) [660] {330}	13,773 (2,755) [661] {331}	13,788 (2,758) [662] {331}
Saratoga	602	610	616	623	638 (128) [31] {15}	652 (130) [31] {16}	666 (133) [32] {16}
Schenectady	864	868	883	891	901 (180) [43] {22}	912 (182) [44] {22}	923 (185) [44] {22}
Suffolk	42,028	42,112	42,214	42,267	42,407 (8,481) [2,036] {1,018}	42,554 (8,511) [2,043] {1,021}	42,709 (8,542) [2,050] {1,025}
Sullivan	1,465	1,466	1,466	1,467	1,468 (294) [70] {35}	1,470 (294) [71] {35}	1,471 (294) [71] {35}
Tompkins	186	190	194	198	203 (41) [10] {5}	211 (42) [10] {5}	221 (44) [11] {5}
Ulster	1,859	1,862	1,872	1,888	1,897 (379) [91] {46}	1,906 (381) [91] {46}	1,915 (383) [92] {46}
Westchester	35,297	35,327	35,366	35,394	35,455 (7,091) [1,702] {851}	35,515 (7,103) [1,705] {852}	35,573 (7,115) [1,707] {854}

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.