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

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 7/7/20 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
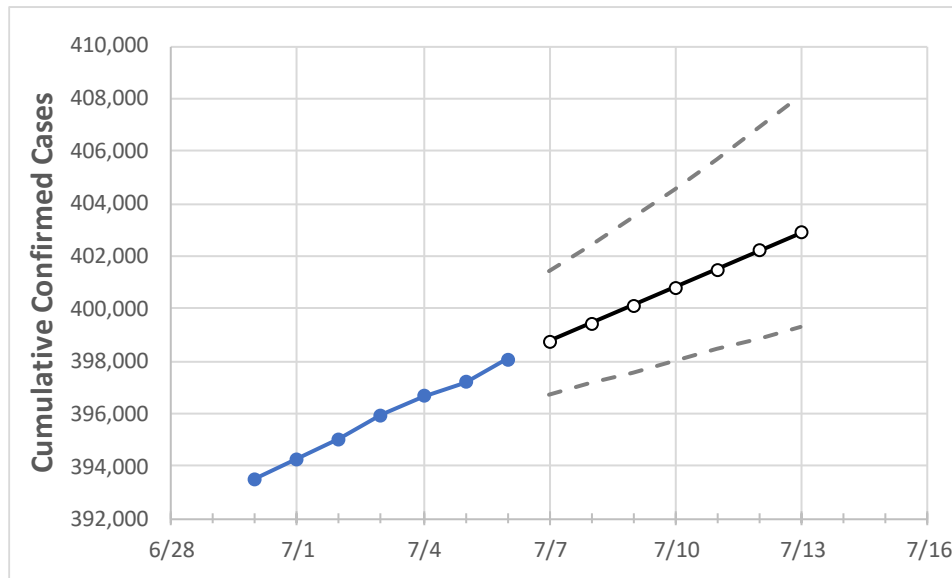
	Actual Confirmed Cases On:				Projected Cases For:						
	7/3	7/4	7/5	7/6	7/7	7/8	7/9	7/10	7/11	7/12	7/13
New York	395,939	396,663	397,200	398,064	398,746	399,430	400,116	400,804	401,494	402,185	402,878

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:						
	7/3	7/4	7/5	7/6	7/7	7/8	7/9	7/10	7/11	7/12	7/13
Albany	2,130	2,145	2,152	2,160	2,168	2,176	2,185	2,193	2,202	2,212	2,222
Bronx	47,838	47,902	47,938	47,994	48,048	48,100	48,153	48,204	48,254	48,304	48,353
Dutchess	4,231	4,238	4,243	4,246	4,251	4,256	4,261	4,266	4,270	4,275	4,279
Erie	7,427	7,462	7,475	7,500	7,528	7,555	7,582	7,609	7,636	7,662	7,688
Kings	59,957	60,078	60,149	60,211	60,295	60,377	60,459	60,540	60,620	60,699	60,778
Monroe	3,885	3,922	3,953	3,974	4,011	4,050	4,089	4,129	4,171	4,213	4,257
Nassau	41,947	41,988	42,031	42,053	42,090	42,126	42,162	42,198	42,234	42,270	42,306
New York	28,698	28,760	28,804	28,870	28,930	28,991	29,052	29,113	29,175	29,237	29,300
Niagara	1,262	1,277	1,284	1,290	1,298	1,307	1,316	1,325	1,335	1,345	1,355
Onondaga	2,909	2,928	2,949	2,963	2,983	3,003	3,023	3,043	3,063	3,084	3,104
Orange	10,759	10,766	10,775	10,781	10,788	10,796	10,803	10,810	10,817	10,824	10,831
Putnam	1,333	1,335	1,336	1,337	1,339	1,341	1,342	1,344	1,346	1,348	1,350
Queens	65,705	65,800	65,876	65,928	66,004	66,080	66,154	66,227	66,299	66,370	66,441
Rensselaer	559	563	565	568	570	572	574	576	578	580	582
Richmond	14,164	14,190	14,202	14,213	14,230	14,247	14,265	14,283	14,300	14,318	14,337
Rockland	13,623	13,629	13,648	13,656	13,665	13,674	13,682	13,691	13,700	13,708	13,717
Saratoga	561	562	566	572	574	577	579	582	585	588	590
Schenectady	824	831	834	838	843	848	853	858	864	869	875
Suffolk	41,538	41,585	41,642	41,685	41,732	41,780	41,827	41,875	41,922	41,970	42,018
Sullivan	1,455	1,456	1,457	1,457	1,458	1,458	1,458	1,459	1,459	1,460	1,460
Tompkins	178	179	179	179	179	180	180	181	181	181	182
Ulster	1,815	1,825	1,834	1,840	1,848	1,856	1,865	1,874	1,885	1,896	1,908
Westchester	34,980	35,020	35,043	35,084	35,122	35,161	35,200	35,240	35,280	35,320	35,361

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: | | |
	7/3	7/4	7/5	7/6	7/8	7/10	7/12
Albany	2,130	2,145	2,152	2,160	2,176 (435) [104] {52}	2,193 (439) [105] {53}	2,212 (442) [106] {53}
Bronx	47,838	47,902	47,938	47,994	48,100 (9,620) [2,309] {1,154}	48,204 (9,641) [2,314] {1,157}	48,304 (9,661) [2,319] {1,159}
Dutchess	4,231	4,238	4,243	4,246	4,256 (851) [204] {102}	4,266 (853) [205] {102}	4,275 (855) [205] {103}
Erie	7,427	7,462	7,475	7,500	7,555 (1,511) [363] {181}	7,609 (1,522) [365] {183}	7,662 (1,532) [368] {184}
Kings	59,957	60,078	60,149	60,211	60,377 (12,075) [2,898] {1,449}	60,540 (12,108) [2,906] {1,453}	60,699 (12,140) [2,914] {1,457}
Monroe	3,885	3,922	3,953	3,974	4,050 (810) [194] {97}	4,129 (826) [198] {99}	4,213 (843) [202] {101}
Nassau	41,947	41,988	42,031	42,053	42,126 (8,425) [2,022] {1,011}	42,198 (8,440) [2,026] {1,013}	42,270 (8,454) [2,029] {1,014}
New York	28,698	28,760	28,804	28,870	28,991 (5,798) [1,392] {696}	29,113 (5,823) [1,397] {699}	29,237 (5,847) [1,403] {702}
Niagara	1,262	1,277	1,284	1,290	1,307 (261) [63] {31}	1,325 (265) [64] {32}	1,345 (269) [65] {32}
Onondaga	2,909	2,928	2,949	2,963	3,003 (601) [144] {72}	3,043 (609) [146] {73}	3,084 (617) [148] {74}
Orange	10,759	10,766	10,775	10,781	10,796 (2,159) [518] {259}	10,810 (2,162) [519] {259}	10,824 (2,165) [520] {260}
Putnam	1,333	1,335	1,336	1,337	1,341 (268) [64] {32}	1,344 (269) [65] {32}	1,348 (270) [65] {32}
Queens	65,705	65,800	65,876	65,928	66,080 (13,216) [3,172] {1,586}	66,227 (13,245) [3,179] {1,589}	66,370 (13,274) [3,186] {1,593}
Rensselaer	559	563	565	568	572 (114) [27] {14}	576 (115) [28] {14}	580 (116) [28] {14}
Richmond	14,164	14,190	14,202	14,213	14,247 (2,849) [684] {342}	14,283 (2,857) [686] {343}	14,318 (2,864) [687] {344}
Rockland	13,623	13,629	13,648	13,656	13,674 (2,735) [656] {328}	13,691 (2,738) [657] {329}	13,708 (2,742) [658] {329}
Saratoga	561	562	566	572	577 (115) [28] {14}	582 (116) [28] {14}	588 (118) [28] {14}
Schenectady	824	831	834	838	848 (170) [41] {20}	858 (172) [41] {21}	869 (174) [42] {21}
Suffolk	41,538	41,585	41,642	41,685	41,780 (8,356) [2,005] {1,003}	41,875 (8,375) [2,010] {1,005}	41,970 (8,394) [2,015] {1,007}
Sullivan	1,455	1,456	1,457	1,457	1,458 (292) [70] {35}	1,459 (292) [70] {35}	1,460 (292) [70] {35}
Tompkins	178	179	179	179	180 (36) [9] {4}	181 (36) [9] {4}	181 (36) [9] {4}
Ulster	1,815	1,825	1,834	1,840	1,856 (371) [89] {45}	1,874 (375) [90] {45}	1,896 (379) [91] {46}
Westchester	34,980	35,020	35,043	35,084	35,161 (7,032) [1,688] {844}	35,240 (7,048) [1,692] {846}	35,320 (7,064) [1,695] {848}

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.