IEM's AI Modeling: Short-term COVID-19 Projections
Date: 7/21/20

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 <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 7/21/20 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.

New York State Projections
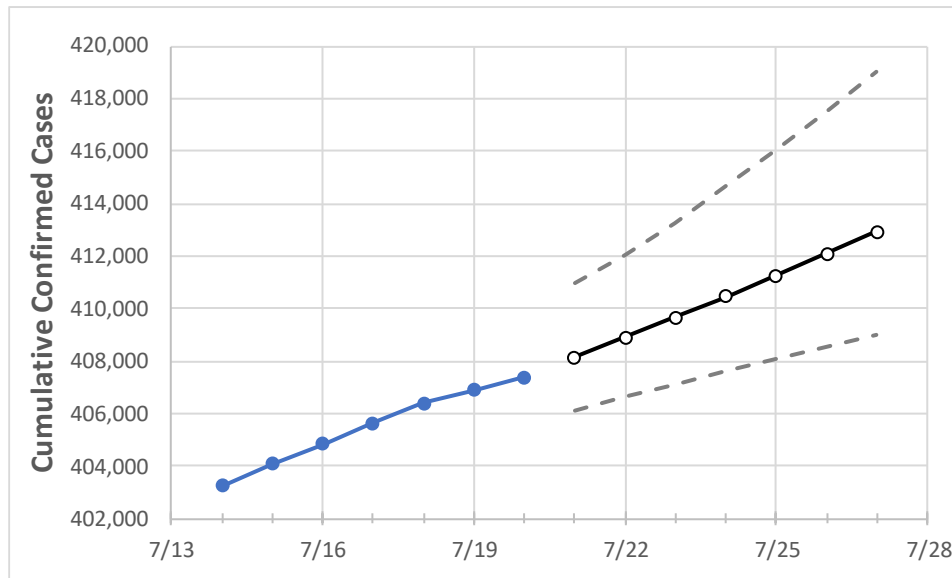
	Actual Confirmed Cases On:				**Projected Cases For:**						
	7/17	7/18	7/19	7/20	7/21	7/22	7/23	7/24	7/25	7/26	7/27
New York	405,620	406,374	406,876	407,395	408,137	408,895	409,669	410,459	411,265	412,087	412,926

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:						
	7/17	7/18	7/19	7/20	7/21	7/22	7/23	7/24	7/25	7/26	7/27
Albany	2,310	2,315	2,318	2,322	2,331	2,340	2,349	2,358	2,367	2,376	2,385
Bronx	48,643	48,715	48,769	48,837	48,904	48,971	49,039	49,108	49,177	49,247	49,318
Dutchess	4,363	4,373	4,376	4,376	4,387	4,399	4,411	4,424	4,437	4,452	4,466
Erie	7,982	8,016	8,035	8,046	8,077	8,107	8,137	8,167	8,197	8,226	8,255
Kings	61,233	61,351	61,432	61,488	61,578	61,667	61,757	61,847	61,937	62,026	62,116
Monroe	4,353	4,383	4,401	4,422	4,449	4,476	4,503	4,529	4,554	4,580	4,604
Nassau	42,555	42,594	42,622	42,678	42,725	42,772	42,819	42,868	42,916	42,966	43,016
New York	29,590	29,675	29,731	29,796	29,867	29,939	30,012	30,085	30,159	30,234	30,310
Niagara	1,371	1,375	1,382	1,384	1,390	1,395	1,400	1,406	1,411	1,416	1,421
Onondaga	3,240	3,262	3,278	3,290	3,310	3,329	3,348	3,367	3,385	3,403	3,422
Orange	10,908	10,921	10,931	10,938	10,949	10,961	10,973	10,985	10,997	11,010	11,023
Putnam	1,386	1,390	1,391	1,392	1,395	1,398	1,401	1,403	1,406	1,409	1,412
Queens	66,829	66,921	67,007	67,079	67,160	67,241	67,322	67,403	67,484	67,565	67,646
Rensselaer	643	650	651	653	657	661	666	670	674	679	683
Richmond	14,439	14,459	14,480	14,503	14,527	14,551	14,576	14,601	14,627	14,653	14,680
Rockland	13,775	13,784	13,793	13,798	13,807	13,816	13,825	13,834	13,843	13,852	13,860
Saratoga	630	635	637	639	643	647	651	656	660	664	669
Schenectady	902	910	915	915	921	928	935	942	949	956	963
Suffolk	42,382	42,440	42,466	42,496	42,545	42,593	42,640	42,687	42,734	42,780	42,826
Sullivan	1,471	1,473	1,473	1,473	1,474	1,476	1,477	1,478	1,480	1,481	1,483
Tompkins	199	199	208	209	211	214	217	220	224	228	233
Ulster	1,898	1,900	1,901	1,901	1,905	1,908	1,912	1,915	1,918	1,922	1,925
Westchester	35,463	35,503	35,515	35,551	35,579	35,607	35,634	35,660	35,687	35,713	35,738

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:		
	7/17	7/18	7/19	7/20	7/22	7/24	7/26
Albany	2,310	2,315	2,318	2,322	2,340 (468) [112] {56}	2,358 (472) [113] {57}	2,376 (475) [114] {57}
Bronx	48,643	48,715	48,769	48,837	48,971 (9,794) [2,351] {1,175}	49,108 (9,822) [2,357] {1,179}	49,247 (9,849) [2,364] {1,182}
Dutchess	4,363	4,373	4,376	4,376	4,399 (880) [211] {106}	4,424 (885) [212] {106}	4,452 (890) [214] {107}
Erie	7,982	8,016	8,035	8,046	8,107 (1,621) [389] {195}	8,167 (1,633) [392] {196}	8,226 (1,645) [395] {197}
Kings	61,233	61,351	61,432	61,488	61,667 (12,333) [2,960] {1,480}	61,847 (12,369) [2,969] {1,484}	62,026 (12,405) [2,977] {1,489}
Monroe	4,353	4,383	4,401	4,422	4,476 (895) [215] {107}	4,529 (906) [217] {109}	4,580 (916) [220] {110}
Nassau	42,555	42,594	42,622	42,678	42,772 (8,554) [2,053] {1,027}	42,868 (8,574) [2,058] {1,029}	42,966 (8,593) [2,062] {1,031}
New York	29,590	29,675	29,731	29,796	29,939 (5,988) [1,437] {719}	30,085 (6,017) [1,444] {722}	30,234 (6,047) [1,451] {726}
Niagara	1,371	1,375	1,382	1,384	1,395 (279) [67] {33}	1,406 (281) [67] {34}	1,416 (283) [68] {34}
Onondaga	3,240	3,262	3,278	3,290	3,329 (666) [160] {80}	3,367 (673) [162] {81}	3,403 (681) [163] {82}
Orange	10,908	10,921	10,931	10,938	10,961 (2,192) [526] {263}	10,985 (2,197) [527] {264}	11,010 (2,202) [528] {264}
Putnam	1,386	1,390	1,391	1,392	1,398 (280) [67] {34}	1,403 (281) [67] {34}	1,409 (282) [68] {34}
Queens	66,829	66,921	67,007	67,079	67,241 (13,448) [3,228] {1,614}	67,403 (13,481) [3,235] {1,618}	67,565 (13,513) [3,243] {1,622}
Rensselaer	643	650	651	653	661 (132) [32] {16}	670 (134) [32] {16}	679 (136) [33] {16}
Richmond	14,439	14,459	14,480	14,503	14,551 (2,910) [698] {349}	14,601 (2,920) [701] {350}	14,653 (2,931) [703] {352}
Rockland	13,775	13,784	13,793	13,798	13,816 (2,763) [663] {332}	13,834 (2,767) [664] {332}	13,852 (2,770) [665] {332}
Saratoga	630	635	637	639	647 (129) [31] {16}	656 (131) [31] {16}	664 (133) [32] {16}
Schenectady	902	910	915	915	928 (186) [45] {22}	942 (188) [45] {23}	956 (191) [46] {23}
Suffolk	42,382	42,440	42,466	42,496	42,593 (8,519) [2,044] {1,022}	42,687 (8,537) [2,049] {1,024}	42,780 (8,556) [2,053] {1,027}
Sullivan	1,471	1,473	1,473	1,473	1,476 (295) [71] {35}	1,478 (296) [71] {35}	1,481 (296) [71] {36}
Tompkins	199	199	208	209	214 (43) [10] {5}	220 (44) [11] {5}	228 (46) [11] {5}
Ulster	1,898	1,900	1,901	1,901	1,908 (382) [92] {46}	1,915 (383) [92] {46}	1,922 (384) [92] {46}
Westchester	35,463	35,503	35,515	35,551	35,607 (7,121) [1,709] {855}	35,660 (7,132) [1,712] {856}	35,713 (7,143) [1,714] {857}

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.