IEM's AI Modeling: Short-term COVID-19 Projections
Date: 7/22/20

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 7/22/20 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
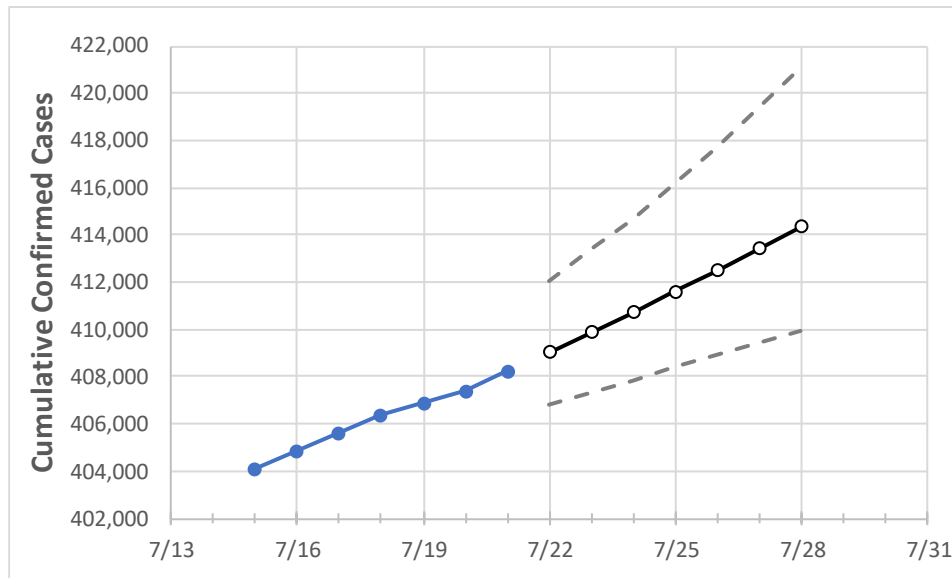
	Actual Confirmed Cases On:				Projected Cases For:						
	7/18	7/19	7/20	7/21	7/22	7/23	7/24	7/25	7/26	7/27	7/28
New York	406,374	406,876	407,395	408,250	409,053	409,877	410,723	411,593	412,485	413,402	414,343

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:						
	7/18	7/19	7/20	7/21	7/22	7/23	7/24	7/25	7/26	7/27	7/28
Albany	2,315	2,318	2,322	2,351	2,362	2,372	2,383	2,395	2,406	2,418	2,431
Bronx	48,715	48,769	48,837	48,926	48,992	49,059	49,127	49,195	49,265	49,335	49,407
Dutchess	4,373	4,376	4,378	4,380	4,386	4,391	4,396	4,402	4,407	4,413	4,418
Erie	8,016	8,035	8,046	8,106	8,138	8,170	8,202	8,234	8,265	8,297	8,328
Kings	61,351	61,432	61,488	61,568	61,654	61,740	61,826	61,912	61,998	62,084	62,170
Monroe	4,383	4,401	4,422	4,452	4,479	4,507	4,534	4,561	4,588	4,616	4,643
Nassau	42,594	42,622	42,678	42,729	42,777	42,826	42,875	42,925	42,976	43,028	43,080
New York	29,675	29,731	29,796	29,867	29,936	30,007	30,078	30,151	30,225	30,300	30,376
Niagara	1,375	1,382	1,384	1,388	1,393	1,397	1,401	1,406	1,410	1,414	1,419
Onondaga	3,262	3,278	3,290	3,312	3,331	3,351	3,370	3,390	3,409	3,429	3,448
Orange	10,921	10,931	10,938	10,953	10,966	10,980	10,995	11,009	11,025	11,041	11,058
Putnam	1,390	1,391	1,392	1,393	1,395	1,397	1,399	1,401	1,403	1,405	1,407
Queens	66,921	67,007	67,079	67,194	67,276	67,358	67,441	67,524	67,608	67,692	67,777
Rensselaer	650	651	653	658	662	666	671	675	679	684	689
Richmond	14,459	14,480	14,503	14,539	14,563	14,588	14,614	14,640	14,667	14,695	14,724
Rockland	13,784	13,793	13,798	13,806	13,814	13,823	13,831	13,840	13,848	13,857	13,865
Saratoga	635	637	639	646	650	655	660	665	670	675	680
Schenectady	910	915	921	926	933	939	946	954	961	969	978
Suffolk	42,440	42,466	42,496	42,575	42,624	42,673	42,721	42,769	42,818	42,865	42,913
Sullivan	1,473	1,473	1,473	1,473	1,475	1,476	1,478	1,479	1,481	1,483	1,485
Tompkins	199	208	209	209	212	214	217	221	225	229	234
Ulster	1,900	1,901	1,904	1,906	1,909	1,912	1,915	1,917	1,920	1,923	1,926
Westchester	35,503	35,515	35,551	35,587	35,615	35,642	35,669	35,696	35,722	35,749	35,774

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:		
	7/18	7/19	7/20	7/21	7/23	7/25	7/27
Albany	2,315	2,318	2,322	2,351	2,372 (474) [114] {57}	2,395 (479) [115] {57}	2,418 (484) [116] {58}
Bronx	48,715	48,769	48,837	48,926	49,059 (9,812) [2,355] {1,177}	49,195 (9,839) [2,361] {1,181}	49,335 (9,867) [2,368] {1,184}
Dutchess	4,373	4,376	4,378	4,380	4,391 (878) [211] {105}	4,402 (880) [211] {106}	4,413 (883) [212] {106}
Erie	8,016	8,035	8,046	8,106	8,170 (1,634) [392] {196}	8,234 (1,647) [395] {198}	8,297 (1,659) [398] {199}
Kings	61,351	61,432	61,488	61,568	61,740 (12,348) [2,964] {1,482}	61,912 (12,382) [2,972] {1,486}	62,084 (12,417) [2,980] {1,490}
Monroe	4,383	4,401	4,422	4,452	4,507 (901) [216] {108}	4,561 (912) [219] {109}	4,616 (923) [222] {111}
Nassau	42,594	42,622	42,678	42,729	42,826 (8,565) [2,056] {1,028}	42,925 (8,585) [2,060] {1,030}	43,028 (8,606) [2,065] {1,033}
New York	29,675	29,731	29,796	29,867	30,007 (6,001) [1,440] {720}	30,151 (6,030) [1,447] {724}	30,300 (6,060) [1,454] {727}
Niagara	1,375	1,382	1,384	1,388	1,397 (279) [67] {34}	1,406 (281) [67] {34}	1,414 (283) [68] {34}
Onondaga	3,262	3,278	3,290	3,312	3,351 (670) [161] {80}	3,390 (678) [163] {81}	3,429 (686) [165] {82}
Orange	10,921	10,931	10,938	10,953	10,980 (2,196) [527] {264}	11,009 (2,202) [528] {264}	11,041 (2,208) [530] {265}
Putnam	1,390	1,391	1,392	1,393	1,397 (279) [67] {34}	1,401 (280) [67] {34}	1,405 (281) [67] {34}
Queens	66,921	67,007	67,079	67,194	67,358 (13,472) [3,233] {1,617}	67,524 (13,505) [3,241] {1,621}	67,692 (13,538) [3,249] {1,625}
Rensselaer	650	651	653	658	666 (133) [32] {16}	675 (135) [32] {16}	684 (137) [33] {16}
Richmond	14,459	14,480	14,503	14,539	14,588 (2,918) [700] {350}	14,640 (2,928) [703] {351}	14,695 (2,939) [705] {353}
Rockland	13,784	13,793	13,798	13,806	13,823 (2,765) [663] {332}	13,840 (2,768) [664] {332}	13,857 (2,771) [665] {333}
Saratoga	635	637	639	646	655 (131) [31] {16}	665 (133) [32] {16}	675 (135) [32] {16}
Schenectady	910	915	921	926	939 (188) [45] {23}	954 (191) [46] {23}	969 (194) [47] {23}
Suffolk	42,440	42,466	42,496	42,575	42,673 (8,535) [2,048] {1,024}	42,769 (8,554) [2,053] {1,026}	42,865 (8,573) [2,058] {1,029}
Sullivan	1,473	1,473	1,473	1,473	1,476 (295) [71] {35}	1,479 (296) [71] {36}	1,483 (297) [71] {36}
Tompkins	199	208	209	209	214 (43) [10] {5}	221 (44) [11] {5}	229 (46) [11] {5}
Ulster	1,900	1,901	1,904	1,906	1,912 (382) [92] {46}	1,917 (383) [92] {46}	1,923 (385) [92] {46}
Westchester	35,503	35,515	35,551	35,587	35,642 (7,128) [1,711] {855}	35,696 (7,139) [1,713] {857}	35,749 (7,150) [1,716] {858}

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.