IEM's AI Modeling: Short-term COVID-19 Projections
Date: 12/10/20

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 not 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 12/10/20 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
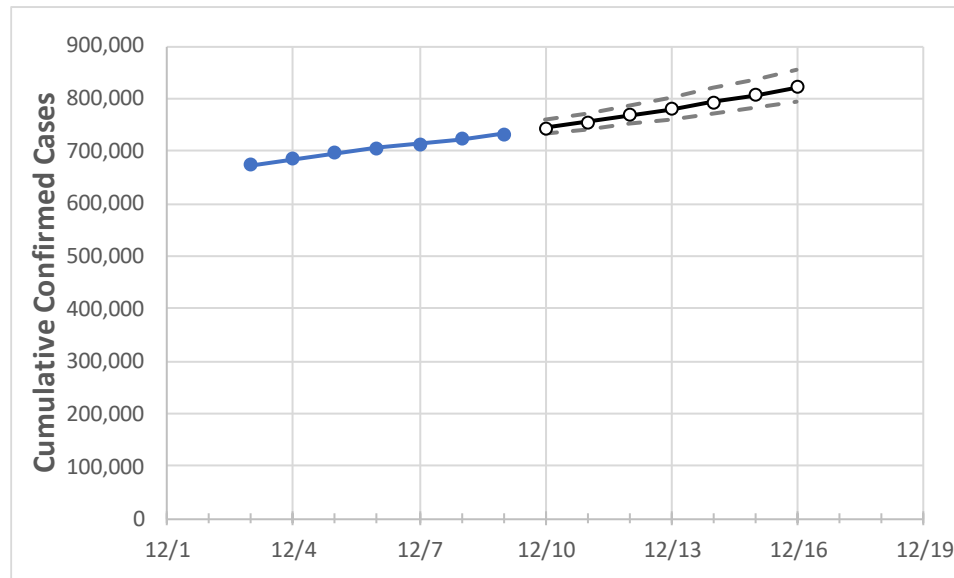
	Actual Confirmed Cases On:				Projected Cases For:						
	12/6	12/7	12/8	12/9	12/10	12/11	12/12	12/13	12/14	12/15	12/16
New York	705,827	713,129	722,464	733,064	744,243	755,860	767,932	780,476	793,509	807,049	821,114

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:						
	12/6	12/7	12/8	12/9	12/10	12/11	12/12	12/13	12/14	12/15	12/16
Albany	6,711	6,818	6,991	7,176	7,359	7,551	7,752	7,963	8,184	8,416	8,660
Bronx	67,257	67,754	68,445	69,004	69,670	70,362	71,083	71,833	72,613	73,425	74,270
Dutchess	8,099	8,192	8,339	8,456	8,611	8,774	8,944	9,123	9,311	9,508	9,715
Erie	29,337	29,720	30,073	30,719	31,316	31,919	32,528	33,143	33,765	34,393	35,027
Kings	94,312	95,047	96,020	97,093	98,160	99,275	100,441	101,659	102,933	104,263	105,653
Monroe	19,074	19,518	19,871	20,648	21,314	22,007	22,728	23,478	24,259	25,070	25,915
Nassau	65,098	65,632	66,495	67,203	68,046	68,921	69,830	70,774	71,753	72,770	73,824
New York	48,521	48,962	49,372	49,907	50,462	51,030	51,612	52,206	52,815	53,437	54,074
Niagara	4,813	4,952	5,077	5,266	5,463	5,672	5,893	6,126	6,373	6,634	6,910
Onondaga	12,662	12,941	13,188	13,598	13,944	14,304	14,678	15,068	15,472	15,893	16,331
Orange	18,219	18,349	18,534	18,720	18,938	19,164	19,398	19,642	19,895	20,157	20,429
Putnam	3,331	3,368	3,428	3,489	3,576	3,667	3,763	3,864	3,970	4,080	4,197
Queens	95,446	96,267	97,147	98,294	99,365	100,483	101,650	102,868	104,139	105,465	106,848
Rensselaer	2,100	2,145	2,210	2,269	2,341	2,417	2,499	2,585	2,677	2,775	2,878
Richmond	25,470	25,741	26,248	26,676	27,156	27,659	28,185	28,736	29,312	29,915	30,545
Rockland	22,800	22,897	23,072	23,308	23,509	23,715	23,927	24,145	24,369	24,600	24,837
Saratoga	2,734	2,787	2,888	2,965	3,060	3,160	3,267	3,380	3,499	3,625	3,758
Schenectady	3,032	3,081	3,179	3,272	3,383	3,503	3,630	3,765	3,910	4,065	4,230
Suffolk	67,112	67,860	69,024	69,996	71,214	72,496	73,844	75,260	76,750	78,316	79,961
Sullivan	2,302	2,315	2,326	2,347	2,363	2,380	2,396	2,413	2,430	2,448	2,465
Tompkins	1,306	1,336	1,398	1,424	1,464	1,506	1,550	1,596	1,644	1,695	1,748
Ulster	3,858	3,897	3,974	4,029	4,115	4,204	4,299	4,398	4,501	4,610	4,724
Westchester	54,671	55,187	55,797	56,372	57,102	57,854	58,628	59,425	60,245	61,089	61,957

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:		
	12/6	12/7	12/8	12/9	12/11	12/13	12/15
Albany	6,711	6,818	6,991	7,176	7,551 (1,510) [362] {181}	7,963 (1,593) [382] {191}	8,416 (1,683) [404] {202}
Bronx	67,257	67,754	68,445	69,004	70,362 (14,072) [3,377] {1,689}	71,833 (14,367) [3,448] {1,724}	73,425 (14,685) [3,524] {1,762}
Dutchess	8,099	8,192	8,339	8,456	8,774 (1,755) [421] {211}	9,123 (1,825) [438] {219}	9,508 (1,902) [456] {228}
Erie	29,337	29,720	30,073	30,719	31,919 (6,384) [1,532] {766}	33,143 (6,629) [1,591] {795}	34,393 (6,879) [1,651] {825}
Kings	94,312	95,047	96,020	97,093	99,275 (19,855) [4,765] {2,383}	101,659 (20,332) [4,880] {2,440}	104,263 (20,853) [5,005] {2,502}
Monroe	19,074	19,518	19,871	20,648	22,007 (4,401) [1,056] {528}	23,478 (4,696) [1,127] {563}	25,070 (5,014) [1,203] {602}
Nassau	65,098	65,632	66,495	67,203	68,921 (13,784) [3,308] {1,654}	70,774 (14,155) [3,397] {1,699}	72,770 (14,554) [3,493] {1,746}
New York	48,521	48,962	49,372	49,907	51,030 (10,206) [2,449] {1,225}	52,206 (10,441) [2,506] {1,253}	53,437 (10,687) [2,565] {1,282}
Niagara	4,813	4,952	5,077	5,266	5,672 (1,134) [272] {136}	6,126 (1,225) [294] {147}	6,634 (1,327) [318] {159}
Onondaga	12,662	12,941	13,188	13,598	14,304 (2,861) [687] {343}	15,068 (3,014) [723] {362}	15,893 (3,179) [763] {381}
Orange	18,219	18,349	18,534	18,720	19,164 (3,833) [920] {460}	19,642 (3,928) [943] {471}	20,157 (4,031) [968] {484}
Putnam	3,331	3,368	3,428	3,489	3,667 (733) [176] {88}	3,864 (773) [185] {93}	4,080 (816) [196] {98}
Queens	95,446	96,267	97,147	98,294	100,483 (20,097) [4,823] {2,412}	102,868 (20,574) [4,938] {2,469}	105,465 (21,093) [5,062] {2,531}
Rensselaer	2,100	2,145	2,210	2,269	2,417 (483) [116] {58}	2,585 (517) [124] {62}	2,775 (555) [133] {67}
Richmond	25,470	25,741	26,248	26,676	27,659 (5,532) [1,328] {664}	28,736 (5,747) [1,379] {690}	29,915 (5,983) [1,436] {718}
Rockland	22,800	22,897	23,072	23,308	23,715 (4,743) [1,138] {569}	24,145 (4,829) [1,159] {579}	24,600 (4,920) [1,181] {590}
Saratoga	2,734	2,787	2,888	2,965	3,160 (632) [152] {76}	3,380 (676) [162] {81}	3,625 (725) [174] {87}
Schenectady	3,032	3,081	3,179	3,272	3,503 (701) [168] {84}	3,765 (753) [181] {90}	4,065 (813) [195] {98}
Suffolk	67,112	67,860	69,024	69,996	72,496 (14,499) [3,480] {1,740}	75,260 (15,052) [3,613] {1,806}	78,316 (15,663) [3,759] {1,880}
Sullivan	2,302	2,315	2,326	2,347	2,380 (476) [114] {57}	2,413 (483) [116] {58}	2,448 (490) [117] {59}
Tompkins	1,306	1,336	1,398	1,424	1,506 (301) [72] {36}	1,596 (319) [77] {38}	1,695 (339) [81] {41}
Ulster	3,858	3,897	3,974	4,029	4,204 (841) [202] {101}	4,398 (880) [211] {106}	4,610 (922) [221] {111}
Westchester	54,671	55,187	55,797	56,372	57,854 (11,571) [2,777] {1,388}	59,425 (11,885) [2,852] {1,426}	61,089 (12,218) [2,932] {1,466}

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.