IEM's AI Modeling: Short-term COVID-19 Projections
Date: 12/7/20

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 10%, and are often within 5%, of actual confirmed cases.

The projections shown in this document are based on data pulled in as of 12/7/20 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
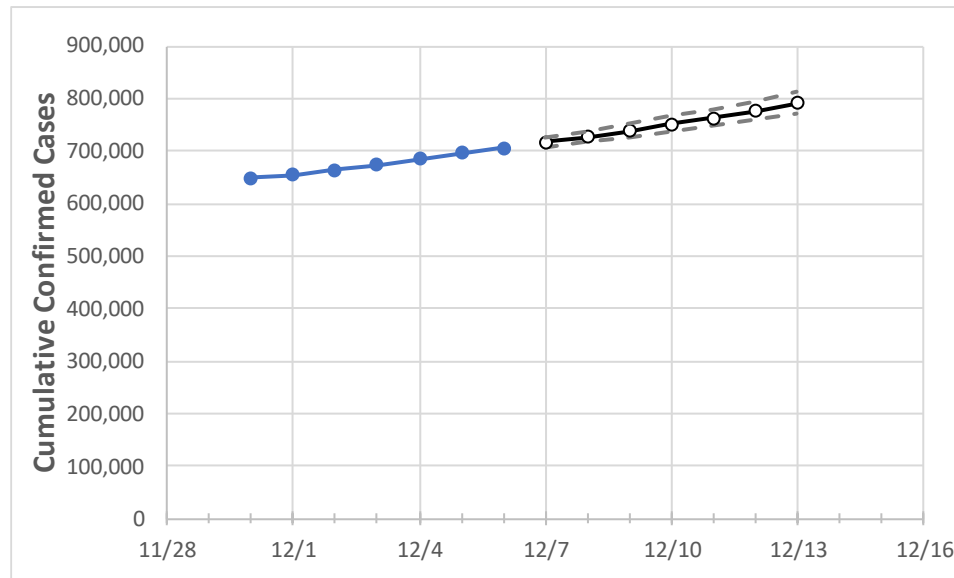
	Actual Confirmed Cases On:				Projected Cases For:						
	12/3	12/4	12/5	12/6	12/7	12/8	12/9	12/10	12/11	12/12	12/13
New York	674,093	685,364	696,125	705,827	716,345	727,345	738,849	750,876	763,450	776,593	790,330

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.

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New York Counties

	Actual Confirmed Cases On:				Projected Cases For:						
	12/3	12/4	12/5	12/6	12/7	12/8	12/9	12/10	12/11	12/12	12/13
Albany	6,258	6,406	6,571	6,711	6,868	7,032	7,206	7,388	7,580	7,782	7,994
Bronx	65,530	66,128	66,682	67,257	67,858	68,484	69,137	69,818	70,529	71,270	72,043
Dutchess	7,635	7,798	7,955	8,099	8,235	8,379	8,529	8,686	8,851	9,024	9,206
Erie	27,110	27,903	28,681	29,337	30,048	30,781	31,537	32,316	33,118	33,944	34,795
Kings	91,647	92,595	93,508	94,312	95,172	96,064	96,990	97,949	98,945	99,977	101,048
Monroe	17,127	17,910	18,453	19,074	19,727	20,412	21,132	21,887	22,679	23,510	24,381
Nassau	62,745	63,661	64,359	65,098	65,867	66,668	67,502	68,370	69,273	70,214	71,192
New York	46,858	47,451	47,994	48,521	49,068	49,633	50,217	50,821	51,444	52,088	52,753
Niagara	4,296	4,479	4,678	4,813	4,985	5,167	5,361	5,568	5,786	6,019	6,266
Onondaga	11,657	11,933	12,358	12,662	12,943	13,232	13,530	13,836	14,151	14,475	14,808
Orange	17,496	17,716	18,018	18,219	18,425	18,639	18,861	19,093	19,333	19,583	19,842
Putnam	3,038	3,107	3,233	3,331	3,419	3,514	3,616	3,725	3,842	3,968	4,103
Queens	92,813	93,723	94,584	95,446	96,339	97,270	98,240	99,251	100,304	101,400	102,543
Rensselaer	1,891	1,968	2,034	2,100	2,159	2,221	2,287	2,357	2,432	2,511	2,595
Richmond	24,205	24,753	25,111	25,470	25,880	26,309	26,756	27,224	27,711	28,220	28,751
Rockland	22,221	22,421	22,633	22,800	22,986	23,177	23,375	23,578	23,787	24,003	24,225
Saratoga	2,488	2,581	2,672	2,734	2,819	2,908	3,003	3,104	3,211	3,324	3,443
Schenectady	2,699	2,819	2,957	3,032	3,138	3,251	3,374	3,505	3,647	3,799	3,963
Suffolk	63,758	64,929	65,993	67,112	68,183	69,313	70,506	71,764	73,091	74,491	75,966
Sullivan	2,238	2,261	2,288	2,302	2,320	2,338	2,357	2,376	2,396	2,416	2,436
Tompkins	1,209	1,241	1,279	1,306	1,343	1,383	1,424	1,468	1,515	1,564	1,616
Ulster	3,606	3,697	3,773	3,858	3,948	4,044	4,146	4,256	4,372	4,497	4,629
Westchester	52,418	53,186	53,944	54,671	55,429	56,224	57,055	57,926	58,838	59,793	60,791

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:		
	12/3	12/4	12/5	12/6	12/8	12/10	12/12
Albany	6,258	6,406	6,571	6,711	7,032 (1,406) [338] {169}	7,388 (1,478) [355] {177}	7,782 (1,556) [374] {187}
Bronx	65,530	66,128	66,682	67,257	68,484 (13,697) [3,287] {1,644}	69,818 (13,964) [3,351] {1,676}	71,270 (14,254) [3,421] {1,710}
Dutchess	7,635	7,798	7,955	8,099	8,379 (1,676) [402] {201}	8,686 (1,737) [417] {208}	9,024 (1,805) [433] {217}
Erie	27,110	27,903	28,681	29,337	30,781 (6,156) [1,478] {739}	32,316 (6,463) [1,551] {776}	33,944 (6,789) [1,629] {815}
Kings	91,647	92,595	93,508	94,312	96,064 (19,213) [4,611] {2,306}	97,949 (19,590) [4,702] {2,351}	99,977 (19,995) [4,799] {2,399}
Monroe	17,127	17,910	18,453	19,074	20,412 (4,082) [980] {490}	21,887 (4,377) [1,051] {525}	23,510 (4,702) [1,128] {564}
Nassau	62,745	63,661	64,359	65,098	66,668 (13,334) [3,200] {1,600}	68,370 (13,674) [3,282] {1,641}	70,214 (14,043) [3,370] {1,685}
New York	46,858	47,451	47,994	48,521	49,633 (9,927) [2,382] {1,191}	50,821 (10,164) [2,439] {1,220}	52,088 (10,418) [2,500] {1,250}
Niagara	4,296	4,479	4,678	4,813	5,167 (1,033) [248] {124}	5,568 (1,114) [267] {134}	6,019 (1,204) [289] {144}
Onondaga	11,657	11,933	12,358	12,662	13,232 (2,646) [635] {318}	13,836 (2,767) [664] {332}	14,475 (2,895) [695] {347}
Orange	17,496	17,716	18,018	18,219	18,639 (3,728) [895] {447}	19,093 (3,819) [916] {458}	19,583 (3,917) [940] {470}
Putnam	3,038	3,107	3,233	3,331	3,514 (703) [169] {84}	3,725 (745) [179] {89}	3,968 (794) [190] {95}
Queens	92,813	93,723	94,584	95,446	97,270 (19,454) [4,669] {2,334}	99,251 (19,850) [4,764] {2,382}	101,400 (20,280) [4,867] {2,434}
Rensselaer	1,891	1,968	2,034	2,100	2,221 (444) [107] {53}	2,357 (471) [113] {57}	2,511 (502) [121] {60}
Richmond	24,205	24,753	25,111	25,470	26,309 (5,262) [1,263] {631}	27,224 (5,445) [1,307] {653}	28,220 (5,644) [1,355] {677}
Rockland	22,221	22,421	22,633	22,800	23,177 (4,635) [1,113] {556}	23,578 (4,716) [1,132] {566}	24,003 (4,801) [1,152] {576}
Saratoga	2,488	2,581	2,672	2,734	2,908 (582) [140] {70}	3,104 (621) [149] {74}	3,324 (665) [160] {80}
Schenectady	2,699	2,819	2,957	3,032	3,251 (650) [156] {78}	3,505 (701) [168] {84}	3,799 (760) [182] {91}
Suffolk	63,758	64,929	65,993	67,112	69,313 (13,863) [3,327] {1,664}	71,764 (14,353) [3,445] {1,722}	74,491 (14,898) [3,576] {1,788}
Sullivan	2,238	2,261	2,288	2,302	2,338 (468) [112] {56}	2,376 (475) [114] {57}	2,416 (483) [116] {58}
Tompkins	1,209	1,241	1,279	1,306	1,383 (277) [66] {33}	1,468 (294) [70] {35}	1,564 (313) [75] {38}
Ulster	3,606	3,697	3,773	3,858	4,044 (809) [194] {97}	4,256 (851) [204] {102}	4,497 (899) [216] {108}
Westchester	52,418	53,186	53,944	54,671	56,224 (11,245) [2,699] {1,349}	57,926 (11,585) [2,780] {1,390}	59,793 (11,959) [2,870] {1,435}

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.