IEM's AI Modeling: Short-term COVID-19 Projections
Date: 11/17/20

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 11/17/20 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
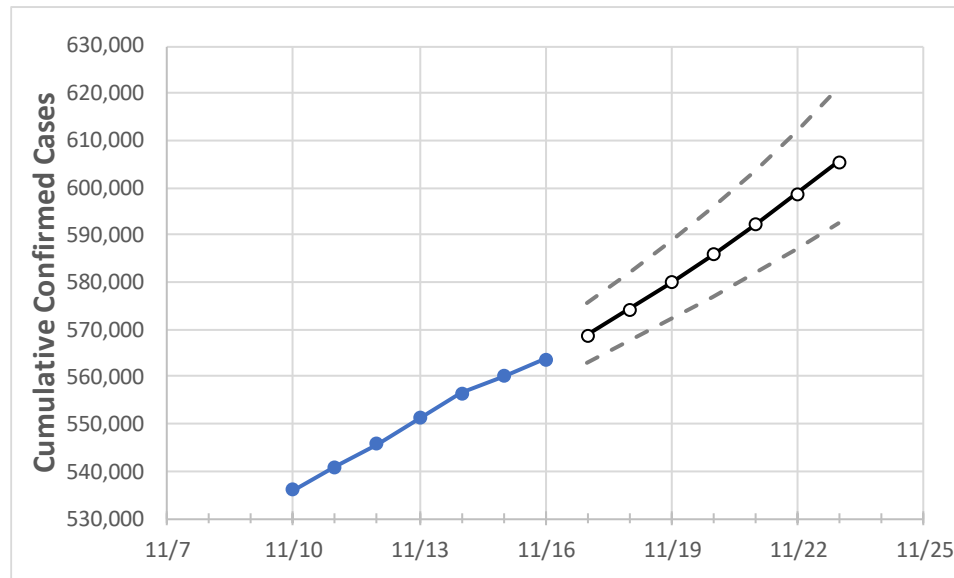
	Actual Confirmed Cases On:				Projected Cases For:						
	11/13	11/14	11/15	11/16	11/17	11/18	11/19	11/20	11/21	11/22	11/23
New York	551,163	556,551	560,200	563,690	568,832	574,230	579,896	585,842	592,083	598,631	605,503

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:						
	11/13	11/14	11/15	11/16	11/17	11/18	11/19	11/20	11/21	11/22	11/23
Albany	4,425	4,514	4,529	4,572	4,640	4,711	4,786	4,865	4,947	5,034	5,124
Bronx	58,205	58,491	58,712	58,905	59,182	59,472	59,774	60,090	60,419	60,763	61,122
Dutchess	6,074	6,144	6,185	6,224	6,292	6,365	6,443	6,525	6,614	6,708	6,808
Erie	17,021	17,469	17,746	18,018	18,578	19,191	19,861	20,593	21,394	22,268	23,224
Kings	80,491	80,946	81,371	81,686	82,154	82,637	83,137	83,653	84,188	84,740	85,311
Monroe	10,074	10,329	10,453	10,680	10,987	11,315	11,666	12,039	12,438	12,864	13,318
Nassau	53,271	53,688	54,014	54,309	54,712	55,139	55,591	56,071	56,579	57,117	57,688
New York	39,355	39,700	39,975	40,226	40,562	40,916	41,289	41,681	42,094	42,529	42,986
Niagara	2,616	2,678	2,708	2,753	2,819	2,890	2,966	3,049	3,137	3,232	3,335
Onondaga	7,421	7,650	7,749	7,892	8,118	8,361	8,620	8,898	9,195	9,513	9,853
Orange	14,910	15,031	15,124	15,182	15,295	15,412	15,533	15,659	15,789	15,924	16,065
Putnam	2,091	2,134	2,153	2,186	2,219	2,254	2,292	2,333	2,378	2,425	2,476
Queens	81,486	81,971	82,356	82,775	83,265	83,782	84,326	84,898	85,502	86,137	86,806
Rensselaer	1,278	1,304	1,321	1,333	1,353	1,374	1,396	1,420	1,445	1,472	1,501
Richmond	19,265	19,491	19,642	19,749	19,952	20,168	20,395	20,636	20,891	21,160	21,445
Rockland	19,567	19,723	19,843	19,904	20,027	20,152	20,281	20,412	20,546	20,683	20,824
Saratoga	1,642	1,666	1,680	1,694	1,714	1,735	1,757	1,778	1,801	1,824	1,847
Schenectady	1,828	1,860	1,871	1,890	1,916	1,943	1,971	2,002	2,034	2,068	2,104
Suffolk	52,493	52,942	53,308	53,653	54,092	54,564	55,072	55,618	56,204	56,835	57,513
Sullivan	1,956	1,969	1,979	1,981	1,990	2,000	2,009	2,018	2,028	2,037	2,047
Tompkins	786	799	806	811	820	830	840	851	861	872	884
Ulster	2,738	2,768	2,788	2,800	2,823	2,848	2,874	2,901	2,930	2,961	2,993
Westchester	43,656	44,093	44,346	44,576	44,935	45,315	45,716	46,140	46,589	47,062	47,563

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:		
	11/13	11/14	11/15	11/16	11/18	11/20	11/22
Albany	4,425	4,514	4,529	4,572	4,711 (942) [226] {113}	4,865 (973) [234] {117}	5,034 (1,007) [242] {121}
Bronx	58,205	58,491	58,712	58,905	59,472 (11,894) [2,855] {1,427}	60,090 (12,018) [2,884] {1,442}	60,763 (12,153) [2,917] {1,458}
Dutchess	6,074	6,144	6,185	6,224	6,365 (1,273) [306] {153}	6,525 (1,305) [313] {157}	6,708 (1,342) [322] {161}
Erie	17,021	17,469	17,746	18,018	19,191 (3,838) [921] {461}	20,593 (4,119) [988] {494}	22,268 (4,454) [1,069] {534}
Kings	80,491	80,946	81,371	81,686	82,637 (16,527) [3,967] {1,983}	83,653 (16,731) [4,015] {2,008}	84,740 (16,948) [4,068] {2,034}
Monroe	10,074	10,329	10,453	10,680	11,315 (2,263) [543] {272}	12,039 (2,408) [578] {289}	12,864 (2,573) [617] {309}
Nassau	53,271	53,688	54,014	54,309	55,139 (11,028) [2,647] {1,323}	56,071 (11,214) [2,691] {1,346}	57,117 (11,423) [2,742] {1,371}
New York	39,355	39,700	39,975	40,226	40,916 (8,183) [1,964] {982}	41,681 (8,336) [2,001] {1,000}	42,529 (8,506) [2,041] {1,021}
Niagara	2,616	2,678	2,708	2,753	2,890 (578) [139] {69}	3,049 (610) [146] {73}	3,232 (646) [155] {78}
Onondaga	7,421	7,650	7,749	7,892	8,361 (1,672) [401] {201}	8,898 (1,780) [427] {214}	9,513 (1,903) [457] {228}
Orange	14,910	15,031	15,124	15,182	15,412 (3,082) [740] {370}	15,659 (3,132) [752] {376}	15,924 (3,185) [764] {382}
Putnam	2,091	2,134	2,153	2,186	2,254 (451) [108] {54}	2,333 (467) [112] {56}	2,425 (485) [116] {58}
Queens	81,486	81,971	82,356	82,775	83,782 (16,756) [4,022] {2,011}	84,898 (16,980) [4,075] {2,038}	86,137 (17,227) [4,135] {2,067}
Rensselaer	1,278	1,304	1,321	1,333	1,374 (275) [66] {33}	1,420 (284) [68] {34}	1,472 (294) [71] {35}
Richmond	19,265	19,491	19,642	19,749	20,168 (4,034) [968] {484}	20,636 (4,127) [991] {495}	21,160 (4,232) [1,016] {508}
Rockland	19,567	19,723	19,843	19,904	20,152 (4,030) [967] {484}	20,412 (4,082) [980] {490}	20,683 (4,137) [993] {496}
Saratoga	1,642	1,666	1,680	1,694	1,735 (347) [83] {42}	1,778 (356) [85] {43}	1,824 (365) [88] {44}
Schenectady	1,828	1,860	1,871	1,890	1,943 (389) [93] {47}	2,002 (400) [96] {48}	2,068 (414) [99] {50}
Suffolk	52,493	52,942	53,308	53,653	54,564 (10,913) [2,619] {1,310}	55,618 (11,124) [2,670] {1,335}	56,835 (11,367) [2,728] {1,364}
Sullivan	1,956	1,969	1,979	1,981	2,000 (400) [96] {48}	2,018 (404) [97] {48}	2,037 (407) [98] {49}
Tompkins	786	799	806	811	830 (166) [40] {20}	851 (170) [41] {20}	872 (174) [42] {21}
Ulster	2,738	2,768	2,788	2,800	2,848 (570) [137] {68}	2,901 (580) [139] {70}	2,961 (592) [142] {71}
Westchester	43,656	44,093	44,346	44,576	45,315 (9,063) [2,175] {1,088}	46,140 (9,228) [2,215] {1,107}	47,062 (9,412) [2,259] {1,129}

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.