IEM's AI Modeling: Short-term COVID-19 Projections
Date: 12/1/20

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 12/1/20 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
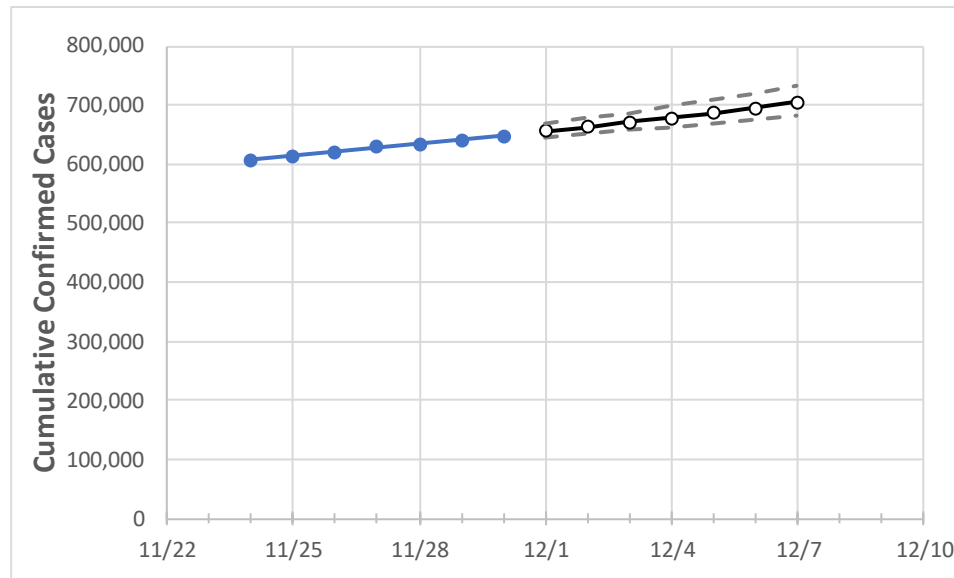
	Actual Confirmed Cases On:				Projected Cases For:						
	11/27	11/28	11/29	11/30	12/1	12/2	12/3	12/4	12/5	12/6	12/7
New York	628,375	634,438	641,161	647,980	655,336	662,917	670,731	678,785	687,085	695,639	704,454

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:						
	11/27	11/28	11/29	11/30	12/1	12/2	12/3	12/4	12/5	12/6	12/7
Albany	5,555	5,618	5,712	5,816	5,923	6,033	6,147	6,265	6,387	6,514	6,644
Bronx	62,770	63,149	63,548	63,997	64,457	64,933	65,425	65,935	66,464	67,011	67,577
Dutchess	7,021	7,122	7,197	7,284	7,375	7,469	7,566	7,666	7,769	7,875	7,985
Erie	23,933	24,440	24,942	25,427	26,040	26,673	27,324	27,996	28,688	29,401	30,136
Kings	87,387	87,979	88,481	89,127	89,754	90,396	91,056	91,732	92,425	93,136	93,864
Monroe	14,338	14,703	15,138	15,660	16,162	16,691	17,248	17,835	18,452	19,102	19,786
Nassau	59,238	59,700	60,181	60,701	61,264	61,845	62,444	63,063	63,701	64,360	65,039
New York	44,218	44,602	45,030	45,442	45,877	46,324	46,781	47,249	47,729	48,220	48,723
Niagara	3,599	3,682	3,768	3,874	3,982	4,096	4,215	4,341	4,474	4,613	4,760
Onondaga	10,248	10,480	10,701	10,804	11,014	11,226	11,440	11,657	11,877	12,098	12,323
Orange	16,555	16,650	16,801	16,891	17,022	17,155	17,290	17,427	17,566	17,707	17,851
Putnam	2,682	2,731	2,789	2,844	2,889	2,937	2,987	3,041	3,098	3,158	3,222
Queens	88,496	89,047	89,681	90,398	91,046	91,712	92,397	93,099	93,821	94,562	95,324
Rensselaer	1,666	1,686	1,720	1,746	1,781	1,816	1,853	1,891	1,931	1,972	2,014
Richmond	22,209	22,404	22,735	23,015	23,296	23,585	23,884	24,192	24,511	24,839	25,177
Rockland	21,258	21,378	21,502	21,632	21,760	21,890	22,021	22,154	22,288	22,423	22,561
Saratoga	2,151	2,180	2,245	2,293	2,351	2,412	2,477	2,545	2,618	2,694	2,775
Schenectady	2,353	2,389	2,443	2,481	2,537	2,596	2,659	2,726	2,797	2,873	2,953
Suffolk	59,273	59,810	60,414	61,072	61,775	62,506	63,266	64,058	64,881	65,737	66,628
Sullivan	2,156	2,166	2,191	2,202	2,220	2,239	2,259	2,279	2,300	2,322	2,345
Tompkins	1,043	1,076	1,105	1,118	1,149	1,183	1,219	1,258	1,299	1,343	1,391
Ulster	3,238	3,276	3,325	3,381	3,434	3,489	3,548	3,610	3,675	3,744	3,816
Westchester	49,102	49,646	50,110	50,693	51,246	51,820	52,416	53,034	53,676	54,341	55,032

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:		
	11/27	11/28	11/29	11/30	12/2	12/4	12/6
Albany	5,555	5,618	5,712	5,816	6,033 (1,207) [290] {145}	6,265 (1,253) [301] {150}	6,514 (1,303) [313] {156}
Bronx	62,770	63,149	63,548	63,997	64,933 (12,987) [3,117] {1,558}	65,935 (13,187) [3,165] {1,582}	67,011 (13,402) [3,217] {1,608}
Dutchess	7,021	7,122	7,197	7,284	7,469 (1,494) [359] {179}	7,666 (1,533) [368] {184}	7,875 (1,575) [378] {189}
Erie	23,933	24,440	24,942	25,427	26,673 (5,335) [1,280] {640}	27,996 (5,599) [1,344] {672}	29,401 (5,880) [1,411] {706}
Kings	87,387	87,979	88,481	89,127	90,396 (18,079) [4,339] {2,170}	91,732 (18,346) [4,403] {2,202}	93,136 (18,627) [4,471] {2,235}
Monroe	14,338	14,703	15,138	15,660	16,691 (3,338) [801] {401}	17,835 (3,567) [856] {428}	19,102 (3,820) [917] {458}
Nassau	59,238	59,700	60,181	60,701	61,845 (12,369) [2,969] {1,484}	63,063 (12,613) [3,027] {1,514}	64,360 (12,872) [3,089] {1,545}
New York	44,218	44,602	45,030	45,442	46,324 (9,265) [2,224] {1,112}	47,249 (9,450) [2,268] {1,134}	48,220 (9,644) [2,315] {1,157}
Niagara	3,599	3,682	3,768	3,874	4,096 (819) [197] {98}	4,341 (868) [208] {104}	4,613 (923) [221] {111}
Onondaga	10,248	10,480	10,701	10,804	11,226 (2,245) [539] {269}	11,657 (2,331) [560] {280}	12,098 (2,420) [581] {290}
Orange	16,555	16,650	16,801	16,891	17,155 (3,431) [823] {412}	17,427 (3,485) [836] {418}	17,707 (3,541) [850] {425}
Putnam	2,682	2,731	2,789	2,844	2,937 (587) [141] {70}	3,041 (608) [146] {73}	3,158 (632) [152] {76}
Queens	88,496	89,047	89,681	90,398	91,712 (18,342) [4,402] {2,201}	93,099 (18,620) [4,469] {2,234}	94,562 (18,912) [4,539] {2,269}
Rensselaer	1,666	1,686	1,720	1,746	1,816 (363) [87] {44}	1,891 (378) [91] {45}	1,972 (394) [95] {47}
Richmond	22,209	22,404	22,735	23,015	23,585 (4,717) [1,132] {566}	24,192 (4,838) [1,161] {581}	24,839 (4,968) [1,192] {596}
Rockland	21,258	21,378	21,502	21,632	21,890 (4,378) [1,051] {525}	22,154 (4,431) [1,063] {532}	22,423 (4,485) [1,076] {538}
Saratoga	2,151	2,180	2,245	2,293	2,412 (482) [116] {58}	2,545 (509) [122] {61}	2,694 (539) [129] {65}
Schenectady	2,353	2,389	2,443	2,481	2,596 (519) [125] {62}	2,726 (545) [131] {65}	2,873 (575) [138] {69}
Suffolk	59,273	59,810	60,414	61,072	62,506 (12,501) [3,000] {1,500}	64,058 (12,812) [3,075] {1,537}	65,737 (13,147) [3,155] {1,578}
Sullivan	2,156	2,166	2,191	2,202	2,239 (448) [107] {54}	2,279 (456) [109] {55}	2,322 (464) [111] {56}
Tompkins	1,043	1,076	1,105	1,118	1,183 (237) [57] {28}	1,258 (252) [60] {30}	1,343 (269) [64] {32}
Ulster	3,238	3,276	3,325	3,381	3,489 (698) [167] {84}	3,610 (722) [173] {87}	3,744 (749) [180] {90}
Westchester	49,102	49,646	50,110	50,693	51,820 (10,364) [2,487] {1,244}	53,034 (10,607) [2,546] {1,273}	54,341 (10,868) [2,608] {1,304}

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.