IEM's AI Modeling: Short-term COVID-19 Projections
Date: 11/4/20

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 11/4/20 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
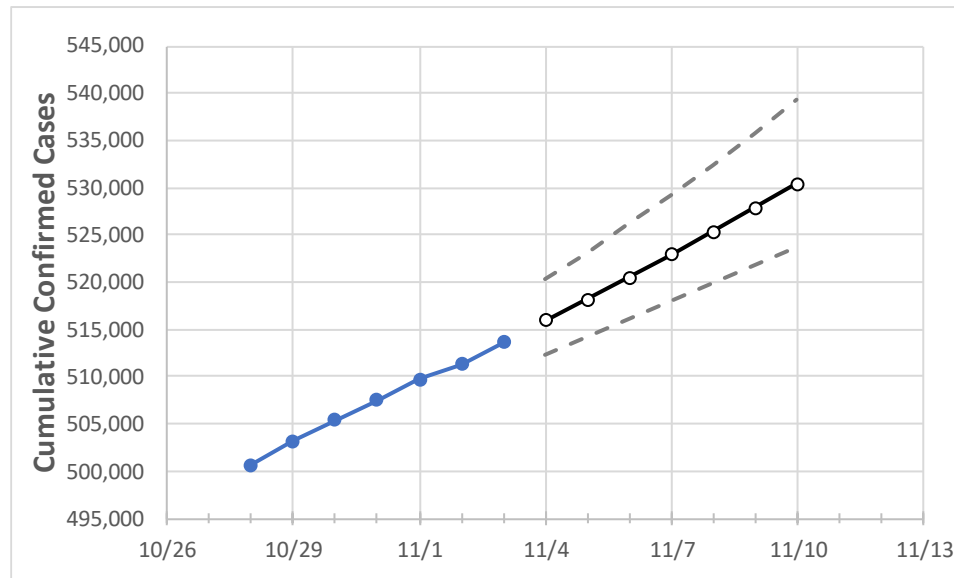
	Actual Confirmed Cases On:				Projected Cases For:						
	10/31	11/1	11/2	11/3	11/4	11/5	11/6	11/7	11/8	11/9	11/10
New York	507,543	509,735	511,368	513,689	515,916	518,196	520,530	522,921	525,368	527,874	530,439

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:						
	10/31	11/1	11/2	11/3	11/4	11/5	11/6	11/7	11/8	11/9	11/10
Albany	3,725	3,750	3,771	3,802	3,831	3,860	3,891	3,922	3,955	3,988	4,022
Bronx	55,767	55,912	55,999	56,165	56,307	56,453	56,605	56,761	56,923	57,090	57,262
Dutchess	5,547	5,565	5,585	5,612	5,633	5,655	5,678	5,702	5,727	5,752	5,778
Erie	13,414	13,531	13,584	13,748	13,849	13,954	14,064	14,178	14,297	14,421	14,550
Kings	76,001	76,238	76,446	76,663	76,888	77,113	77,340	77,567	77,796	78,025	78,255
Monroe	7,597	7,705	7,817	7,923	8,036	8,156	8,282	8,415	8,556	8,704	8,860
Nassau	50,158	50,294	50,407	50,602	50,759	50,920	51,086	51,257	51,433	51,615	51,801
New York	36,522	36,712	36,814	36,980	37,141	37,308	37,481	37,660	37,845	38,037	38,235
Niagara	2,124	2,137	2,155	2,166	2,182	2,199	2,216	2,234	2,252	2,271	2,290
Onondaga	5,696	5,762	5,795	5,881	5,949	6,020	6,094	6,170	6,250	6,333	6,420
Orange	13,833	13,889	13,933	13,998	14,059	14,122	14,186	14,252	14,319	14,388	14,459
Putnam	1,845	1,861	1,869	1,874	1,883	1,893	1,903	1,913	1,923	1,934	1,945
Queens	77,412	77,649	77,834	78,013	78,227	78,446	78,669	78,898	79,131	79,370	79,614
Rensselaer	1,116	1,124	1,131	1,135	1,140	1,146	1,151	1,156	1,161	1,167	1,172
Richmond	17,535	17,644	17,703	17,777	17,865	17,957	18,053	18,153	18,257	18,366	18,479
Rockland	18,192	18,265	18,353	18,466	18,554	18,644	18,736	18,829	18,923	19,019	19,117
Saratoga	1,405	1,423	1,438	1,448	1,468	1,490	1,512	1,535	1,559	1,585	1,611
Schenectady	1,601	1,622	1,631	1,644	1,657	1,670	1,684	1,699	1,715	1,732	1,749
Suffolk	49,398	49,538	49,604	49,780	49,904	50,031	50,161	50,294	50,431	50,571	50,715
Sullivan	1,814	1,818	1,825	1,837	1,850	1,864	1,879	1,895	1,911	1,928	1,947
Tompkins	650	656	659	660	665	670	675	679	684	689	693
Ulster	2,547	2,556	2,559	2,568	2,577	2,587	2,596	2,606	2,616	2,627	2,637
Westchester	40,800	40,946	41,061	41,226	41,369	41,517	41,671	41,830	41,994	42,164	42,340

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:		
	10/31	11/1	11/2	11/3	11/5	11/7	11/9
Albany	3,725	3,750	3,771	3,802	3,860 (772) [185] {93}	3,922 (784) [188] {94}	3,988 (798) [191] {96}
Bronx	55,767	55,912	55,999	56,165	56,453 (11,291) [2,710] {1,355}	56,761 (11,352) [2,725] {1,362}	57,090 (11,418) [2,740] {1,370}
Dutchess	5,547	5,565	5,585	5,612	5,655 (1,131) [271] {136}	5,702 (1,140) [274] {137}	5,752 (1,150) [276] {138}
Erie	13,414	13,531	13,584	13,748	13,954 (2,791) [670] {335}	14,178 (2,836) [681] {340}	14,421 (2,884) [692] {346}
Kings	76,001	76,238	76,446	76,663	77,113 (15,423) [3,701] {1,851}	77,567 (15,513) [3,723] {1,862}	78,025 (15,605) [3,745] {1,873}
Monroe	7,597	7,705	7,817	7,923	8,156 (1,631) [391] {196}	8,415 (1,683) [404] {202}	8,704 (1,741) [418] {209}
Nassau	50,158	50,294	50,407	50,602	50,920 (10,184) [2,444] {1,222}	51,257 (10,251) [2,460] {1,230}	51,615 (10,323) [2,477] {1,239}
New York	36,522	36,712	36,814	36,980	37,308 (7,462) [1,791] {895}	37,660 (7,532) [1,808] {904}	38,037 (7,607) [1,826] {913}
Niagara	2,124	2,137	2,155	2,166	2,199 (440) [106] {53}	2,234 (447) [107] {54}	2,271 (454) [109] {55}
Onondaga	5,696	5,762	5,795	5,881	6,020 (1,204) [289] {144}	6,170 (1,234) [296] {148}	6,333 (1,267) [304] {152}
Orange	13,833	13,889	13,933	13,998	14,122 (2,824) [678] {339}	14,252 (2,850) [684] {342}	14,388 (2,878) [691] {345}
Putnam	1,845	1,861	1,869	1,874	1,893 (379) [91] {45}	1,913 (383) [92] {46}	1,934 (387) [93] {46}
Queens	77,412	77,649	77,834	78,013	78,446 (15,689) [3,765] {1,883}	78,898 (15,780) [3,787] {1,894}	79,370 (15,874) [3,810] {1,905}
Rensselaer	1,116	1,124	1,131	1,135	1,146 (229) [55] {27}	1,156 (231) [55] {28}	1,167 (233) [56] {28}
Richmond	17,535	17,644	17,703	17,777	17,957 (3,591) [862] {431}	18,153 (3,631) [871] {436}	18,366 (3,673) [882] {441}
Rockland	18,192	18,265	18,353	18,466	18,644 (3,729) [895] {447}	18,829 (3,766) [904] {452}	19,019 (3,804) [913] {456}
Saratoga	1,405	1,423	1,438	1,448	1,490 (298) [72] {36}	1,535 (307) [74] {37}	1,585 (317) [76] {38}
Schenectady	1,601	1,622	1,631	1,644	1,670 (334) [80] {40}	1,699 (340) [82] {41}	1,732 (346) [83] {42}
Suffolk	49,398	49,538	49,604	49,780	50,031 (10,006) [2,401] {1,201}	50,294 (10,059) [2,414] {1,207}	50,571 (10,114) [2,427] {1,214}
Sullivan	1,814	1,818	1,825	1,837	1,864 (373) [89] {45}	1,895 (379) [91] {45}	1,928 (386) [93] {46}
Tompkins	650	656	659	660	670 (134) [32] {16}	679 (136) [33] {16}	689 (138) [33] {17}
Ulster	2,547	2,556	2,559	2,568	2,587 (517) [124] {62}	2,606 (521) [125] {63}	2,627 (525) [126] {63}
Westchester	40,800	40,946	41,061	41,226	41,517 (8,303) [1,993] {996}	41,830 (8,366) [2,008] {1,004}	42,164 (8,433) [2,024] {1,012}

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.