IEM's AI Modeling: Short-term COVID-19 Projections
Date: 4/15/21

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 4/15/21 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
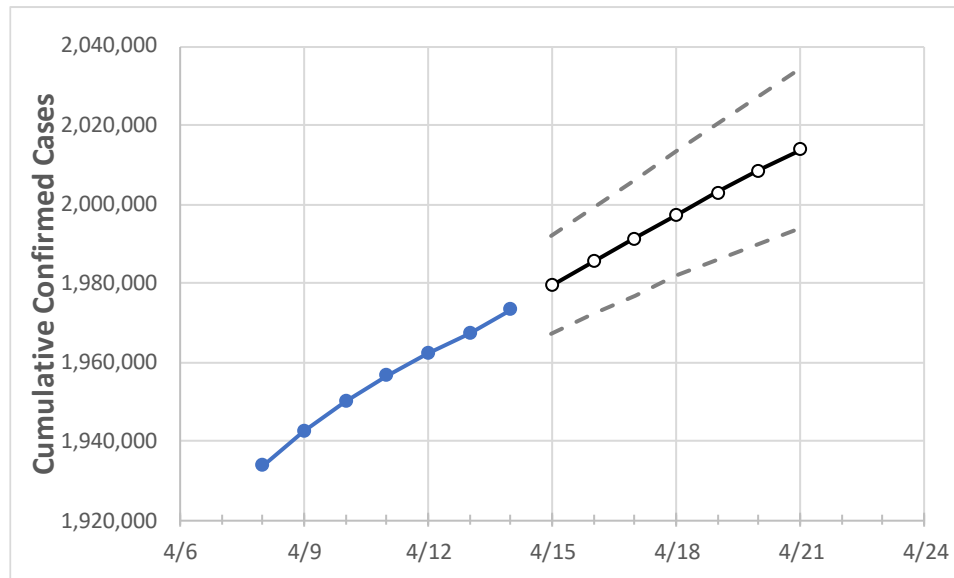
	Actual Confirmed Cases On:				Projected Cases For:						
	4/11	4/12	4/13	4/14	4/15	4/16	4/17	4/18	4/19	4/20	4/21
New York	1,956,594	1,962,225	1,967,248	1,973,308	1,979,464	1,985,525	1,991,383	1,997,158	2,002,867	2,008,429	2,013,825

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

New York Counties

	Actual Confirmed Cases On:				Projected Cases For:						
	4/11	4/12	4/13	4/14	4/15	4/16	4/17	4/18	4/19	4/20	4/21
Albany	23,280	23,323	23,368	23,409	23,462	23,514	23,566	23,617	23,666	23,715	23,763
Bronx	171,900	172,365	172,746	173,109	173,607	174,088	174,565	175,027	175,470	175,915	176,345
Dutchess	27,371	27,449	27,510	27,616	27,713	27,805	27,899	27,990	28,079	28,165	28,252
Erie	79,217	79,580	79,959	80,556	81,085	81,645	82,191	82,754	83,312	83,892	84,484
Kings	258,426	259,343	260,063	261,181	262,106	263,026	263,926	264,837	265,722	266,587	267,441
Monroe	59,315	59,539	59,738	59,944	60,210	60,484	60,761	61,049	61,341	61,639	61,941
Nassau	174,279	174,673	175,023	175,392	175,895	176,374	176,851	177,318	177,781	178,230	178,678
New York	129,488	129,781	130,055	130,384	130,783	131,149	131,532	131,889	132,242	132,590	132,910
Niagara	17,633	17,712	17,780	17,888	18,015	18,147	18,285	18,428	18,573	18,724	18,882
Onondaga	35,353	35,415	35,490	35,576	35,680	35,786	35,893	36,002	36,111	36,222	36,333
Orange	45,194	45,320	45,423	45,583	45,721	45,855	45,989	46,115	46,242	46,363	46,484
Putnam	10,005	10,023	10,052	10,079	10,115	10,152	10,187	10,222	10,256	10,289	10,323
Queens	258,050	258,984	259,732	260,418	261,279	262,122	262,949	263,756	264,548	265,321	266,105
Rensselaer	10,439	10,465	10,495	10,526	10,562	10,598	10,634	10,670	10,706	10,740	10,775
Richmond	69,167	69,440	69,620	69,867	70,128	70,388	70,646	70,898	71,148	71,390	71,632
Rockland	45,068	45,148	45,245	45,345	45,460	45,574	45,685	45,795	45,900	46,008	46,112
Saratoga	14,077	14,122	14,167	14,222	14,282	14,341	14,402	14,462	14,521	14,582	14,643
Schenectady	12,201	12,228	12,252	12,289	12,321	12,353	12,384	12,416	12,448	12,478	12,509
Suffolk	190,014	190,463	190,889	191,379	191,952	192,520	193,075	193,618	194,147	194,668	195,193
Sullivan	5,934	5,958	5,989	6,032	6,069	6,107	6,144	6,182	6,221	6,260	6,299
Tompkins	3,997	4,000	4,003	4,019	4,026	4,032	4,038	4,044	4,050	4,055	4,060
Ulster	12,712	12,755	12,791	12,835	12,888	12,940	12,991	13,040	13,088	13,134	13,179
Westchester	123,838	124,092	124,317	124,535	124,827	125,117	125,405	125,685	125,958	126,229	126,488

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:		
	4/11	4/12	4/13	4/14	4/16	4/18	4/20
Albany	23,280	23,323	23,368	23,409	23,514 (4,703) [1,129] {564}	23,617 (4,723) [1,134] {567}	23,715 (4,743) [1,138] {569}
Bronx	171,900	172,365	172,746	173,109	174,088 (34,818) [8,356] {4,178}	175,027 (35,005) [8,401] {4,201}	175,915 (35,183) [8,444] {4,222}
Dutchess	27,371	27,449	27,510	27,616	27,805 (5,561) [1,335] {667}	27,990 (5,598) [1,344] {672}	28,165 (5,633) [1,352] {676}
Erie	79,217	79,580	79,959	80,556	81,645 (16,329) [3,919] {1,959}	82,754 (16,551) [3,972] {1,986}	83,892 (16,778) [4,027] {2,013}
Kings	258,426	259,343	260,063	261,181	263,026 (52,605) [12,625] {6,313}	264,837 (52,967) [12,712] {6,356}	266,587 (53,317) [12,796] {6,398}
Monroe	59,315	59,539	59,738	59,944	60,484 (12,097) [2,903] {1,452}	61,049 (12,210) [2,930] {1,465}	61,639 (12,328) [2,959] {1,479}
Nassau	174,279	174,673	175,023	175,392	176,374 (35,275) [8,466] {4,233}	177,318 (35,464) [8,511] {4,256}	178,230 (35,646) [8,555] {4,278}
New York	129,488	129,781	130,055	130,384	131,149 (26,230) [6,295] {3,148}	131,889 (26,378) [6,331] {3,165}	132,590 (26,518) [6,364] {3,182}
Niagara	17,633	17,712	17,780	17,888	18,147 (3,629) [871] {436}	18,428 (3,686) [885] {442}	18,724 (3,745) [899] {449}
Onondaga	35,353	35,415	35,490	35,576	35,786 (7,157) [1,718] {859}	36,002 (7,200) [1,728] {864}	36,222 (7,244) [1,739] {869}
Orange	45,194	45,320	45,423	45,583	45,855 (9,171) [2,201] {1,101}	46,115 (9,223) [2,214] {1,107}	46,363 (9,273) [2,225] {1,113}
Putnam	10,005	10,023	10,052	10,079	10,152 (2,030) [487] {244}	10,222 (2,044) [491] {245}	10,289 (2,058) [494] {247}
Queens	258,050	258,984	259,732	260,418	262,122 (52,424) [12,582] {6,291}	263,756 (52,751) [12,660] {6,330}	265,321 (53,064) [12,735] {6,368}
Rensselaer	10,439	10,465	10,495	10,526	10,598 (2,120) [509] {254}	10,670 (2,134) [512] {256}	10,740 (2,148) [516] {258}
Richmond	69,167	69,440	69,620	69,867	70,388 (14,078) [3,379] {1,689}	70,898 (14,180) [3,403] {1,702}	71,390 (14,278) [3,427] {1,713}
Rockland	45,068	45,148	45,245	45,345	45,574 (9,115) [2,188] {1,094}	45,795 (9,159) [2,198] {1,099}	46,008 (9,202) [2,208] {1,104}
Saratoga	14,077	14,122	14,167	14,222	14,341 (2,868) [688] {344}	14,462 (2,892) [694] {347}	14,582 (2,916) [700] {350}
Schenectady	12,201	12,228	12,252	12,289	12,353 (2,471) [593] {296}	12,416 (2,483) [596] {298}	12,478 (2,496) [599] {299}
Suffolk	190,014	190,463	190,889	191,379	192,520 (38,504) [9,241] {4,620}	193,618 (38,724) [9,294] {4,647}	194,668 (38,934) [9,344] {4,672}
Sullivan	5,934	5,958	5,989	6,032	6,107 (1,221) [293] {147}	6,182 (1,236) [297] {148}	6,260 (1,252) [300] {150}
Tompkins	3,997	4,000	4,003	4,019	4,032 (806) [194] {97}	4,044 (809) [194] {97}	4,055 (811) [195] {97}
Ulster	12,712	12,755	12,791	12,835	12,940 (2,588) [621] {311}	13,040 (2,608) [626] {313}	13,134 (2,627) [630] {315}
Westchester	123,838	124,092	124,317	124,535	125,117 (25,023) [6,006] {3,003}	125,685 (25,137) [6,033] {3,016}	126,229 (25,246) [6,059] {3,029}

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.