IEM's AI Modeling: Short-term COVID-19 Projections
Date: 12/17/20

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 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 12/17/20 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
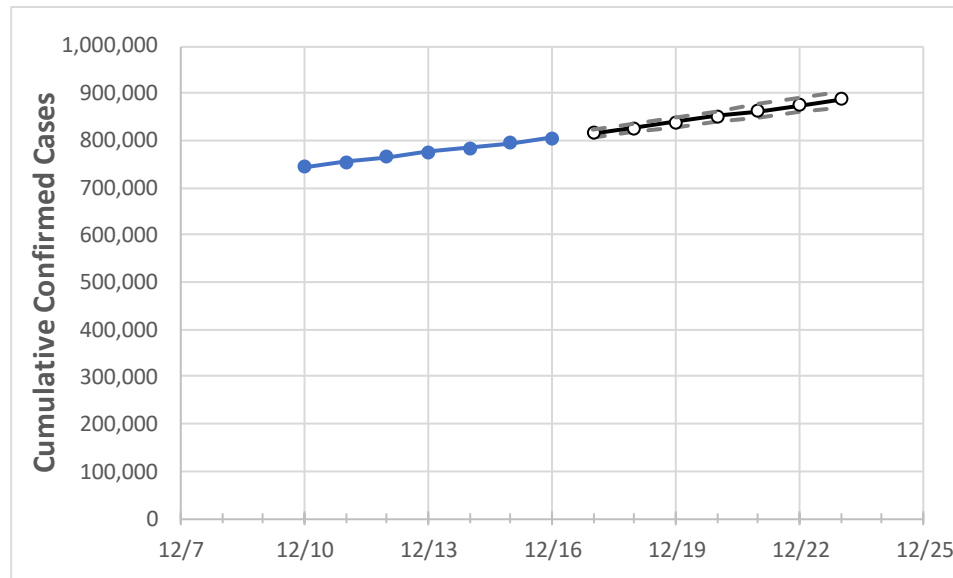
	Actual Confirmed Cases On:				Projected Cases For:						
	12/13	12/14	12/15	12/16	12/17	12/18	12/19	12/20	12/21	12/22	12/23
New York	774,767	784,137	794,557	804,555	815,864	827,337	838,979	850,795	862,787	874,957	887,307

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:						
	12/13	12/14	12/15	12/16	12/17	12/18	12/19	12/20	12/21	12/22	12/23
Albany	7,888	8,050	8,214	8,405	8,612	8,826	9,047	9,276	9,511	9,754	10,005
Bronx	71,263	71,738	72,409	73,010	73,688	74,380	75,086	75,806	76,542	77,292	78,058
Dutchess	9,146	9,290	9,482	9,642	9,836	10,036	10,244	10,459	10,681	10,911	11,149
Erie	33,009	33,397	33,793	34,181	34,710	35,238	35,765	36,291	36,816	37,339	37,861
Kings	101,002	101,832	102,995	103,969	105,112	106,284	107,486	108,719	109,984	111,280	112,609
Monroe	23,203	23,745	24,293	24,946	25,666	26,405	27,162	27,940	28,737	29,554	30,392
Nassau	70,475	71,214	72,122	72,904	73,801	74,714	75,643	76,590	77,554	78,536	79,535
New York	52,203	52,725	53,345	53,872	54,483	55,105	55,738	56,381	57,035	57,699	58,375
Niagara	5,906	6,016	6,144	6,258	6,436	6,618	6,805	6,995	7,189	7,388	7,591
Onondaga	15,182	15,481	15,722	16,054	16,439	16,830	17,230	17,636	18,050	18,472	18,901
Orange	19,507	19,689	19,892	20,114	20,327	20,543	20,761	20,981	21,204	21,429	21,657
Putnam	3,743	3,795	3,869	3,919	3,990	4,063	4,136	4,210	4,284	4,360	4,437
Queens	102,510	103,435	104,668	105,740	106,973	108,244	109,555	110,905	112,296	113,730	115,207
Rensselaer	2,569	2,631	2,712	2,789	2,880	2,974	3,073	3,176	3,283	3,395	3,511
Richmond	28,074	28,351	28,810	29,167	29,600	30,041	30,490	30,947	31,412	31,886	32,369
Rockland	23,991	24,183	24,334	24,555	24,757	24,961	25,169	25,380	25,594	25,812	26,032
Saratoga	3,366	3,477	3,599	3,716	3,844	3,978	4,118	4,265	4,419	4,580	4,748
Schenectady	3,668	3,781	3,924	4,014	4,149	4,291	4,439	4,594	4,757	4,926	5,104
Suffolk	74,367	75,454	76,625	77,681	78,917	80,177	81,460	82,767	84,098	85,454	86,835
Sullivan	2,455	2,469	2,483	2,510	2,533	2,557	2,582	2,607	2,632	2,658	2,685
Tompkins	1,556	1,593	1,613	1,637	1,674	1,712	1,751	1,790	1,830	1,871	1,912
Ulster	4,327	4,393	4,485	4,547	4,637	4,729	4,824	4,922	5,022	5,125	5,230
Westchester	58,837	59,431	59,991	60,540	61,214	61,895	62,582	63,275	63,974	64,680	65,392

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:		
	12/13	12/14	12/15	12/16	12/18	12/20	12/22
Albany	7,888	8,050	8,214	8,405	8,826 (1,765) [424] {212}	9,276 (1,855) [445] {223}	9,754 (1,951) [468] {234}
Bronx	71,263	71,738	72,409	73,010	74,380 (14,876) [3,570] {1,785}	75,806 (15,161) [3,639] {1,819}	77,292 (15,458) [3,710] {1,855}
Dutchess	9,146	9,290	9,482	9,642	10,036 (2,007) [482] {241}	10,459 (2,092) [502] {251}	10,911 (2,182) [524] {262}
Erie	33,009	33,397	33,793	34,181	35,238 (7,048) [1,691] {846}	36,291 (7,258) [1,742] {871}	37,339 (7,468) [1,792] {896}
Kings	101,002	101,832	102,995	103,969	106,284 (21,257) [5,102] {2,551}	108,719 (21,744) [5,219] {2,609}	111,280 (22,256) [5,341] {2,671}
Monroe	23,203	23,745	24,293	24,946	26,405 (5,281) [1,267] {634}	27,940 (5,588) [1,341] {671}	29,554 (5,911) [1,419] {709}
Nassau	70,475	71,214	72,122	72,904	74,714 (14,943) [3,586] {1,793}	76,590 (15,318) [3,676] {1,838}	78,536 (15,707) [3,770] {1,885}
New York	52,203	52,725	53,345	53,872	55,105 (11,021) [2,645] {1,323}	56,381 (11,276) [2,706] {1,353}	57,699 (11,540) [2,770] {1,385}
Niagara	5,906	6,016	6,144	6,258	6,618 (1,324) [318] {159}	6,995 (1,399) [336] {168}	7,388 (1,478) [355] {177}
Onondaga	15,182	15,481	15,722	16,054	16,830 (3,366) [808] {404}	17,636 (3,527) [847] {423}	18,472 (3,694) [887] {443}
Orange	19,507	19,689	19,892	20,114	20,543 (4,109) [986] {493}	20,981 (4,196) [1,007] {504}	21,429 (4,286) [1,029] {514}
Putnam	3,743	3,795	3,869	3,919	4,063 (813) [195] {98}	4,210 (842) [202] {101}	4,360 (872) [209] {105}
Queens	102,510	103,435	104,668	105,740	108,244 (21,649) [5,196] {2,598}	110,905 (22,181) [5,323] {2,662}	113,730 (22,746) [5,459] {2,730}
Rensselaer	2,569	2,631	2,712	2,789	2,974 (595) [143] {71}	3,176 (635) [152] {76}	3,395 (679) [163] {81}
Richmond	28,074	28,351	28,810	29,167	30,041 (6,008) [1,442] {721}	30,947 (6,189) [1,485] {743}	31,886 (6,377) [1,531] {765}
Rockland	23,991	24,183	24,334	24,555	24,961 (4,992) [1,198] {599}	25,380 (5,076) [1,218] {609}	25,812 (5,162) [1,239] {619}
Saratoga	3,366	3,477	3,599	3,716	3,978 (796) [191] {95}	4,265 (853) [205] {102}	4,580 (916) [220] {110}
Schenectady	3,668	3,781	3,924	4,014	4,291 (858) [206] {103}	4,594 (919) [221] {110}	4,926 (985) [236] {118}
Suffolk	74,367	75,454	76,625	77,681	80,177 (16,035) [3,848] {1,924}	82,767 (16,553) [3,973] {1,986}	85,454 (17,091) [4,102] {2,051}
Sullivan	2,455	2,469	2,483	2,510	2,557 (511) [123] {61}	2,607 (521) [125] {63}	2,658 (532) [128] {64}
Tompkins	1,556	1,593	1,613	1,637	1,712 (342) [82] {41}	1,790 (358) [86] {43}	1,871 (374) [90] {45}
Ulster	4,327	4,393	4,485	4,547	4,729 (946) [227] {114}	4,922 (984) [236] {118}	5,125 (1,025) [246] {123}
Westchester	58,837	59,431	59,991	60,540	61,895 (12,379) [2,971] {1,485}	63,275 (12,655) [3,037] {1,519}	64,680 (12,936) [3,105] {1,552}

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.