IEM's AI Modeling: Short-term COVID-19 Projections
Date: 3/29/21

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 <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 3/29/21 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
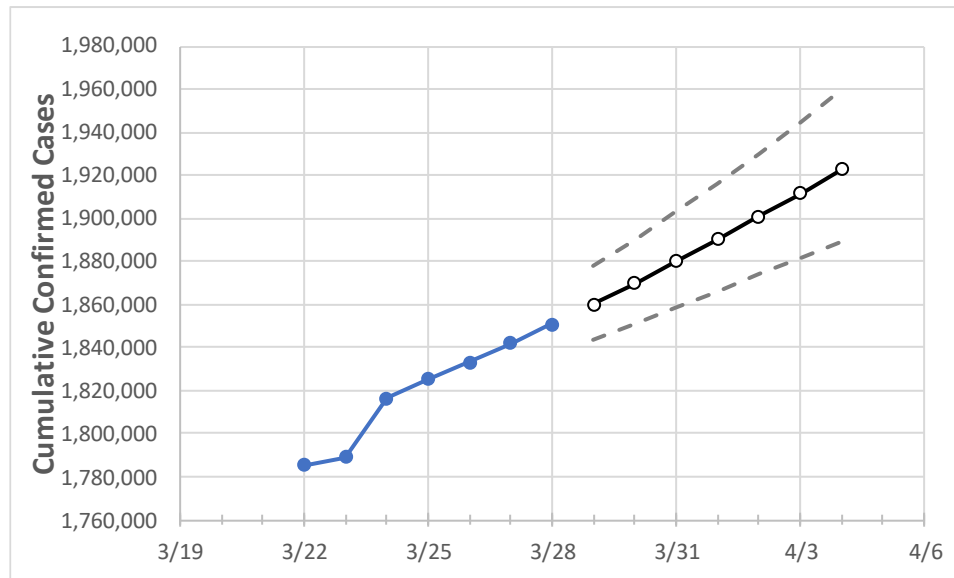
	Actual Confirmed Cases On:				Projected Cases For:						
	3/25	3/26	3/27	3/28	3/29	3/30	3/31	4/1	4/2	4/3	4/4
New York	1,825,069	1,833,128	1,841,822	1,850,732	1,860,300	1,869,945	1,880,135	1,890,358	1,900,861	1,911,731	1,922,578

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:						
	3/25	3/26	3/27	3/28	3/29	3/30	3/31	4/1	4/2	4/3	4/4
Albany	22,214	22,276	22,351	22,418	22,484	22,552	22,620	22,691	22,762	22,833	22,906
Bronx	160,695	161,286	162,068	162,845	163,601	164,390	165,190	165,970	166,762	167,582	168,429
Dutchess	25,282	25,400	25,530	25,671	25,815	25,964	26,114	26,266	26,419	26,573	26,729
Erie	71,439	71,849	72,357	72,732	73,136	73,551	73,982	74,425	74,893	75,370	75,858
Kings	239,337	240,634	241,948	243,329	244,827	246,373	247,951	249,565	251,242	252,943	254,650
Monroe	55,674	55,854	56,049	56,246	56,430	56,621	56,820	57,022	57,231	57,439	57,657
Nassau	163,785	164,481	165,095	165,785	166,433	167,082	167,733	168,384	169,036	169,695	170,340
New York	119,581	120,230	120,892	121,652	122,578	123,530	124,496	125,522	126,541	127,630	128,702
Niagara	16,186	16,239	16,309	16,354	16,405	16,458	16,513	16,568	16,626	16,685	16,746
Onondaga	33,805	33,879	33,978	34,062	34,137	34,216	34,295	34,377	34,460	34,545	34,630
Orange	41,825	42,067	42,328	42,535	42,779	43,023	43,274	43,527	43,783	44,044	44,307
Putnam	9,218	9,278	9,330	9,391	9,443	9,496	9,551	9,606	9,662	9,720	9,780
Queens	238,970	240,094	241,417	242,874	244,325	245,808	247,312	248,840	250,442	252,093	253,754
Rensselaer	9,777	9,824	9,856	9,901	9,937	9,973	10,011	10,048	10,086	10,126	10,165
Richmond	63,965	64,250	64,571	64,908	65,267	65,640	66,027	66,414	66,822	67,224	67,645
Rockland	42,556	42,741	42,932	43,130	43,297	43,465	43,637	43,809	43,982	44,152	44,325
Saratoga	13,034	13,101	13,162	13,217	13,280	13,345	13,412	13,481	13,551	13,624	13,696
Schenectady	11,586	11,642	11,677	11,717	11,764	11,812	11,861	11,912	11,967	12,022	12,079
Suffolk	178,077	178,813	179,524	180,321	181,064	181,820	182,567	183,335	184,110	184,897	185,686
Sullivan	5,336	5,370	5,393	5,421	5,454	5,489	5,525	5,561	5,597	5,635	5,673
Tompkins	3,777	3,807	3,831	3,852	3,873	3,894	3,916	3,940	3,963	3,987	4,013
Ulster	11,528	11,591	11,683	11,787	11,887	11,989	12,097	12,208	12,324	12,444	12,567
Westchester	117,068	117,509	118,001	118,505	118,957	119,411	119,871	120,346	120,823	121,303	121,795

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:		
	3/25	3/26	3/27	3/28	3/30	4/1	4/3
Albany	22,214	22,276	22,351	22,418	22,552 (4,510) [1,082] {541}	22,691 (4,538) [1,089] {545}	22,833 (4,567) [1,096] {548}
Bronx	160,695	161,286	162,068	162,845	164,390 (32,878) [7,891] {3,945}	165,970 (33,194) [7,967] {3,983}	167,582 (33,516) [8,044] {4,022}
Dutchess	25,282	25,400	25,530	25,671	25,964 (5,193) [1,246] {623}	26,266 (5,253) [1,261] {630}	26,573 (5,315) [1,276] {638}
Erie	71,439	71,849	72,357	72,732	73,551 (14,710) [3,530] {1,765}	74,425 (14,885) [3,572] {1,786}	75,370 (15,074) [3,618] {1,809}
Kings	239,337	240,634	241,948	243,329	246,373 (49,275) [11,826] {5,913}	249,565 (49,913) [11,979] {5,990}	252,943 (50,589) [12,141] {6,071}
Monroe	55,674	55,854	56,049	56,246	56,621 (11,324) [2,718] {1,359}	57,022 (11,404) [2,737] {1,369}	57,439 (11,488) [2,757] {1,379}
Nassau	163,785	164,481	165,095	165,785	167,082 (33,416) [8,020] {4,010}	168,384 (33,677) [8,082] {4,041}	169,695 (33,939) [8,145] {4,073}
New York	119,581	120,230	120,892	121,652	123,530 (24,706) [5,929] {2,965}	125,522 (25,104) [6,025] {3,013}	127,630 (25,526) [6,126] {3,063}
Niagara	16,186	16,239	16,309	16,354	16,458 (3,292) [790] {395}	16,568 (3,314) [795] {398}	16,685 (3,337) [801] {400}
Onondaga	33,805	33,879	33,978	34,062	34,216 (6,843) [1,642] {821}	34,377 (6,875) [1,650] {825}	34,545 (6,909) [1,658] {829}
Orange	41,825	42,067	42,328	42,535	43,023 (8,605) [2,065] {1,033}	43,527 (8,705) [2,089] {1,045}	44,044 (8,809) [2,114] {1,057}
Putnam	9,218	9,278	9,330	9,391	9,496 (1,899) [456] {228}	9,606 (1,921) [461] {231}	9,720 (1,944) [467] {233}
Queens	238,970	240,094	241,417	242,874	245,808 (49,162) [11,799] {5,899}	248,840 (49,768) [11,944] {5,972}	252,093 (50,419) [12,100] {6,050}
Rensselaer	9,777	9,824	9,856	9,901	9,973 (1,995) [479] {239}	10,048 (2,010) [482] {241}	10,126 (2,025) [486] {243}
Richmond	63,965	64,250	64,571	64,908	65,640 (13,128) [3,151] {1,575}	66,414 (13,283) [3,188] {1,594}	67,224 (13,445) [3,227] {1,613}
Rockland	42,556	42,741	42,932	43,130	43,465 (8,693) [2,086] {1,043}	43,809 (8,762) [2,103] {1,051}	44,152 (8,830) [2,119] {1,060}
Saratoga	13,034	13,101	13,162	13,217	13,345 (2,669) [641] {320}	13,481 (2,696) [647] {324}	13,624 (2,725) [654] {327}
Schenectady	11,586	11,642	11,677	11,717	11,812 (2,362) [567] {283}	11,912 (2,382) [572] {286}	12,022 (2,404) [577] {289}
Suffolk	178,077	178,813	179,524	180,321	181,820 (36,364) [8,727] {4,364}	183,335 (36,667) [8,800] {4,400}	184,897 (36,979) [8,875] {4,438}
Sullivan	5,336	5,370	5,393	5,421	5,489 (1,098) [263] {132}	5,561 (1,112) [267] {133}	5,635 (1,127) [270] {135}
Tompkins	3,777	3,807	3,831	3,852	3,894 (779) [187] {93}	3,940 (788) [189] {95}	3,987 (797) [191] {96}
Ulster	11,528	11,591	11,683	11,787	11,989 (2,398) [575] {288}	12,208 (2,442) [586] {293}	12,444 (2,489) [597] {299}
Westchester	117,068	117,509	118,001	118,505	119,411 (23,882) [5,732] {2,866}	120,346 (24,069) [5,777] {2,888}	121,303 (24,261) [5,823] {2,911}

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.