IEM's AI Modeling: Short-term COVID-19 Projections

Date: 3/31/21

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 3/31/21 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.

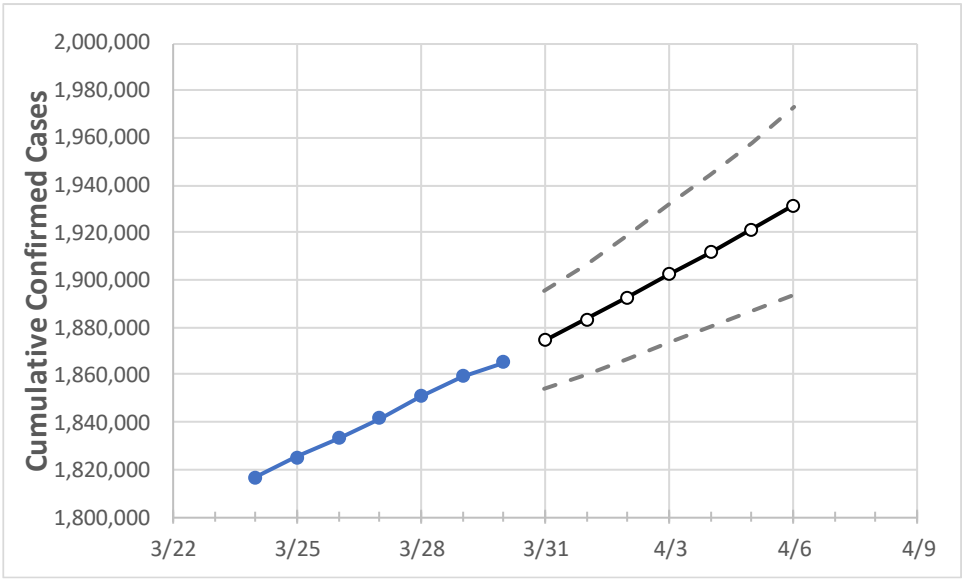
IEM's Modeling Lead

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:						
	3/27	3/28	3/29	3/30	3/31	4/1	4/2	4/3	4/4	4/5	4/6
New York	1,841,822	1,850,732	1,859,474	1,865,349	1,874,427	1,883,521	1,892,870	1,902,318	1,911,812	1,921,558	1,931,501

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:						
	3/27	3/28	3/29	3/30	3/31	4/1	4/2	4/3	4/4	4/5	4/6
Albany	22,351	22,418	22,476	22,536	22,601	22,669	22,737	22,805	22,874	22,944	23,014
Bronx	162,068	162,845	163,984	164,369	165,170	165,973	166,798	167,628	168,463	169,311	170,183
Dutchess	25,530	25,671	25,807	25,893	26,031	26,172	26,313	26,453	26,595	26,740	26,884
Erie	72,357	72,732	73,171	73,561	73,999	74,449	74,914	75,400	75,899	76,413	76,944
Kings	241,948	243,329	244,802	245,458	246,832	248,229	249,648	251,095	252,517	253,979	255,464
Monroe	56,049	56,246	56,399	56,535	56,718	56,906	57,094	57,284	57,486	57,687	57,892
Nassau	165,095	165,785	166,365	166,881	167,488	168,091	168,690	169,284	169,878	170,470	171,050
New York	120,892	121,652	122,271	122,759	123,573	124,404	125,262	126,158	127,034	127,945	128,873
Niagara	16,309	16,354	16,399	16,490	16,551	16,612	16,676	16,743	16,812	16,883	16,955
Onondaga	33,978	34,062	34,127	34,176	34,247	34,318	34,391	34,466	34,542	34,618	34,696
Orange	42,328	42,535	42,769	43,015	43,259	43,503	43,750	44,000	44,253	44,508	44,762
Putnam	9,330	9,391	9,438	9,468	9,516	9,564	9,614	9,664	9,715	9,768	9,822
Queens	241,417	242,874	244,365	245,105	246,505	247,888	249,332	250,807	252,304	253,799	255,329
Rensselaer	9,856	9,901	9,931	9,973	10,011	10,048	10,087	10,126	10,165	10,205	10,246
Richmond	64,571	64,908	65,304	65,516	65,877	66,234	66,603	66,986	67,375	67,777	68,172
Rockland	42,932	43,130	43,237	43,375	43,530	43,683	43,833	43,987	44,140	44,296	44,448
Saratoga	13,162	13,217	13,275	13,338	13,403	13,469	13,537	13,608	13,679	13,753	13,829
Schenectady	11,677	11,717	11,737	11,775	11,817	11,862	11,907	11,954	12,000	12,048	12,097
Suffolk	179,524	180,321	181,006	181,618	182,333	183,055	183,775	184,489	185,220	185,951	186,672
Sullivan	5,393	5,421	5,449	5,482	5,516	5,550	5,585	5,621	5,656	5,692	5,729
Tompkins	3,831	3,852	3,866	3,878	3,897	3,916	3,936	3,956	3,976	3,997	4,017
Ulster	11,683	11,787	11,859	11,918	12,006	12,096	12,187	12,280	12,375	12,471	12,570
Westchester	118,001	118,505	118,964	119,242	119,662	120,085	120,508	120,933	121,357	121,781	122,216

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:		
	3/27	3/28	3/29	3/30	4/1	4/3	4/5
Albany	22,351	22,418	22,476	22,536	22,669 (4,534) [1,088] {544}	22,805 (4,561) [1,095] {547}	22,944 (4,589) [1,101] {551}
Bronx	162,068	162,845	163,984	164,369	165,973 (33,195) [7,967] {3,983}	167,628 (33,526) [8,046] {4,023}	169,311 (33,862) [8,127] {4,063}
Dutchess	25,530	25,671	25,807	25,893	26,172 (5,234) [1,256] {628}	26,453 (5,291) [1,270] {635}	26,740 (5,348) [1,283] {642}
Erie	72,357	72,732	73,171	73,561	74,449 (14,890) [3,574] {1,787}	75,400 (15,080) [3,619] {1,810}	76,413 (15,283) [3,668] {1,834}
Kings	241,948	243,329	244,802	245,458	248,229 (49,646) [11,915] {5,958}	251,095 (50,219) [12,053] {6,026}	253,979 (50,796) [12,191] {6,095}
Monroe	56,049	56,246	56,399	56,535	56,906 (11,381) [2,731] {1,366}	57,284 (11,457) [2,750] {1,375}	57,687 (11,537) [2,769] {1,384}
Nassau	165,095	165,785	166,365	166,881	168,091 (33,618) [8,068] {4,034}	169,284 (33,857) [8,126] {4,063}	170,470 (34,094) [8,183] {4,091}
New York	120,892	121,652	122,271	122,759	124,404 (24,881) [5,971] {2,986}	126,158 (25,232) [6,056] {3,028}	127,945 (25,589) [6,141] {3,071}
Niagara	16,309	16,354	16,399	16,490	16,612 (3,322) [797] {399}	16,743 (3,349) [804] {402}	16,883 (3,377) [810] {405}
Onondaga	33,978	34,062	34,127	34,176	34,318 (6,864) [1,647] {824}	34,466 (6,893) [1,654] {827}	34,618 (6,924) [1,662] {831}
Orange	42,328	42,535	42,769	43,015	43,503 (8,701) [2,088] {1,044}	44,000 (8,800) [2,112] {1,056}	44,508 (8,902) [2,136] {1,068}
Putnam	9,330	9,391	9,438	9,468	9,564 (1,913) [459] {230}	9,664 (1,933) [464] {232}	9,768 (1,954) [469] {234}
Queens	241,417	242,874	244,365	245,105	247,888 (49,578) [11,899] {5,949}	250,807 (50,161) [12,039] {6,019}	253,799 (50,760) [12,182] {6,091}
Rensselaer	9,856	9,901	9,931	9,973	10,048 (2,010) [482] {241}	10,126 (2,025) [486] {243}	10,205 (2,041) [490] {245}
Richmond	64,571	64,908	65,304	65,516	66,234 (13,247) [3,179] {1,590}	66,986 (13,397) [3,215] {1,608}	67,777 (13,555) [3,253] {1,627}
Rockland	42,932	43,130	43,237	43,375	43,683 (8,737) [2,097] {1,048}	43,987 (8,797) [2,111] {1,056}	44,296 (8,859) [2,126] {1,063}
Saratoga	13,162	13,217	13,275	13,338	13,469 (2,694) [647] {323}	13,608 (2,722) [653] {327}	13,753 (2,751) [660] {330}
Schenectady	11,677	11,717	11,737	11,775	11,862 (2,372) [569] {285}	11,954 (2,391) [574] {287}	12,048 (2,410) [578] {289}
Suffolk	179,524	180,321	181,006	181,618	183,055 (36,611) [8,787] {4,393}	184,489 (36,898) [8,855] {4,428}	185,951 (37,190) [8,926] {4,463}
Sullivan	5,393	5,421	5,449	5,482	5,550 (1,110) [266] {133}	5,621 (1,124) [270] {135}	5,692 (1,138) [273] {137}
Tompkins	3,831	3,852	3,866	3,878	3,916 (783) [188] {94}	3,956 (791) [190] {95}	3,997 (799) [192] {96}
Ulster	11,683	11,787	11,859	11,918	12,096 (2,419) [581] {290}	12,280 (2,456) [589] {295}	12,471 (2,494) [599] {299}
Westchester	118,001	118,505	118,964	119,242	120,085 (24,017) [5,764] {2,882}	120,933 (24,187) [5,805] {2,902}	121,781 (24,356) [5,845] {2,923}

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.