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

Date: 4/6/21

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 4/6/21 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.

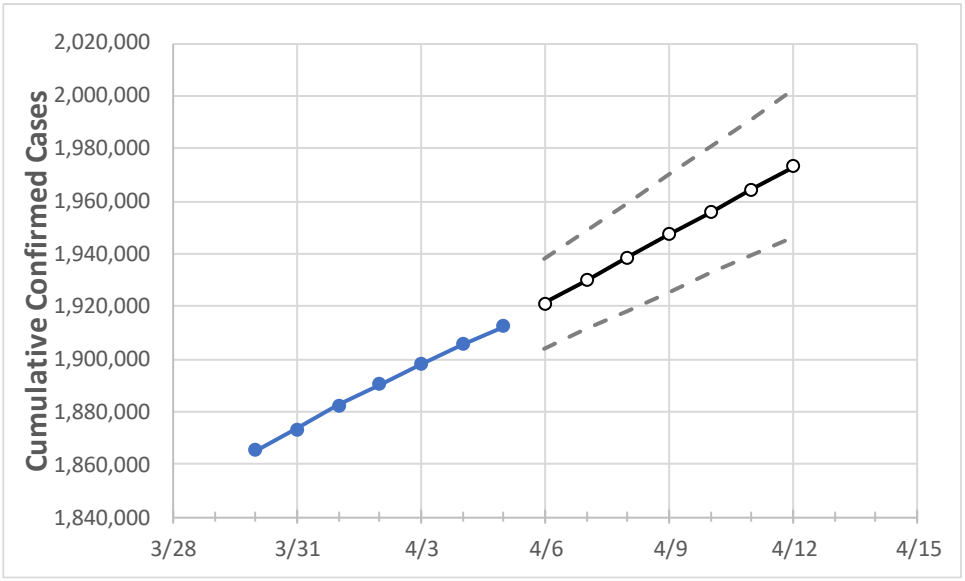
IEM's Modeling Lead

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:						
	4/2	4/3	4/4	4/5	4/6	4/7	4/8	4/9	4/10	4/11	4/12
New York	1,890,346	1,898,101	1,905,737	1,912,396	1,920,994	1,929,712	1,938,532	1,947,235	1,955,801	1,964,450	1,973,012

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:						
	4/2	4/3	4/4	4/5	4/6	4/7	4/8	4/9	4/10	4/11	4/12
Albany	22,738	22,799	22,855	22,925	22,992	23,059	23,126	23,194	23,263	23,331	23,399
Bronx	166,550	167,221	167,901	168,418	169,122	169,849	170,594	171,301	172,038	172,769	173,527
Dutchess	26,329	26,450	26,573	26,680	26,814	26,951	27,085	27,224	27,359	27,494	27,632
Erie	74,919	75,400	75,876	76,365	76,887	77,425	77,976	78,549	79,140	79,752	80,370
Kings	248,953	249,957	251,097	252,049	253,101	254,147	255,177	256,172	257,145	258,106	259,044
Monroe	57,101	57,350	57,538	57,780	58,006	58,237	58,475	58,720	58,967	59,227	59,493
Nassau	168,884	169,535	170,179	170,680	171,297	171,912	172,523	173,124	173,737	174,339	174,948
New York	124,656	125,259	125,851	126,316	126,924	127,545	128,145	128,736	129,296	129,858	130,415
Niagara	16,713	16,800	16,900	17,014	17,107	17,204	17,308	17,414	17,530	17,648	17,773
Onondaga	34,438	34,531	34,629	34,741	34,837	34,934	35,033	35,137	35,244	35,352	35,464
Orange	43,686	43,893	44,048	44,185	44,393	44,601	44,805	45,012	45,213	45,412	45,608
Putnam	9,627	9,679	9,729	9,757	9,807	9,858	9,910	9,962	10,013	10,066	10,121
Queens	248,788	249,836	250,990	251,972	253,216	254,458	255,717	256,997	258,269	259,533	260,776
Rensselaer	10,091	10,137	10,181	10,217	10,259	10,302	10,346	10,390	10,435	10,480	10,528
Richmond	66,501	66,793	67,083	67,363	67,695	68,026	68,366	68,700	69,038	69,370	69,700
Rockland	43,886	44,052	44,150	44,234	44,376	44,517	44,655	44,792	44,930	45,066	45,197
Saratoga	13,533	13,599	13,668	13,713	13,780	13,849	13,918	13,989	14,061	14,133	14,206
Schenectady	11,894	11,917	11,951	11,987	12,028	12,069	12,111	12,153	12,196	12,240	12,282
Suffolk	183,912	184,645	185,345	185,911	186,616	187,326	188,033	188,739	189,442	190,131	190,829
Sullivan	5,622	5,664	5,691	5,710	5,748	5,787	5,827	5,867	5,908	5,950	5,993
Tompkins	3,925	3,932	3,944	3,951	3,965	3,980	3,994	4,008	4,022	4,035	4,049
Ulster	12,126	12,205	12,271	12,322	12,397	12,471	12,546	12,620	12,693	12,767	12,841
Westchester	120,734	121,124	121,507	121,803	122,227	122,641	123,056	123,481	123,902	124,323	124,748

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:		
	4/2	4/3	4/4	4/5	4/7	4/9	4/11
Albany	22,738	22,799	22,855	22,925	23,059 (4,612) [1,107] {553}	23,194 (4,639) [1,113] {557}	23,331 (4,666) [1,120] {560}
Bronx	166,550	167,221	167,901	168,418	169,849 (33,970) [8,153] {4,076}	171,301 (34,260) [8,222] {4,111}	172,769 (34,554) [8,293] {4,146}
Dutchess	26,329	26,450	26,573	26,680	26,951 (5,390) [1,294] {647}	27,224 (5,445) [1,307] {653}	27,494 (5,499) [1,320] {660}
Erie	74,919	75,400	75,876	76,365	77,425 (15,485) [3,716] {1,858}	78,549 (15,710) [3,770] {1,885}	79,752 (15,950) [3,828] {1,914}
Kings	248,953	249,957	251,097	252,049	254,147 (50,829) [12,199] {6,100}	256,172 (51,234) [12,296] {6,148}	258,106 (51,621) [12,389] {6,195}
Monroe	57,101	57,350	57,538	57,780	58,237 (11,647) [2,795] {1,398}	58,720 (11,744) [2,819] {1,409}	59,227 (11,845) [2,843] {1,421}
Nassau	168,884	169,535	170,179	170,680	171,912 (34,382) [8,252] {4,126}	173,124 (34,625) [8,310] {4,155}	174,339 (34,868) [8,368] {4,184}
New York	124,656	125,259	125,851	126,316	127,545 (25,509) [6,122] {3,061}	128,736 (25,747) [6,179] {3,090}	129,858 (25,972) [6,233] {3,117}
Niagara	16,713	16,800	16,900	17,014	17,204 (3,441) [826] {413}	17,414 (3,483) [836] {418}	17,648 (3,530) [847] {424}
Onondaga	34,438	34,531	34,629	34,741	34,934 (6,987) [1,677] {838}	35,137 (7,027) [1,687] {843}	35,352 (7,070) [1,697] {848}
Orange	43,686	43,893	44,048	44,185	44,601 (8,920) [2,141] {1,070}	45,012 (9,002) [2,161] {1,080}	45,412 (9,082) [2,180] {1,090}
Putnam	9,627	9,679	9,729	9,757	9,858 (1,972) [473] {237}	9,962 (1,992) [478] {239}	10,066 (2,013) [483] {242}
Queens	248,788	249,836	250,990	251,972	254,458 (50,892) [12,214] {6,107}	256,997 (51,399) [12,336] {6,168}	259,533 (51,907) [12,458] {6,229}
Rensselaer	10,091	10,137	10,181	10,217	10,302 (2,060) [494] {247}	10,390 (2,078) [499] {249}	10,480 (2,096) [503] {252}
Richmond	66,501	66,793	67,083	67,363	68,026 (13,605) [3,265] {1,633}	68,700 (13,740) [3,298] {1,649}	69,370 (13,874) [3,330] {1,665}
Rockland	43,886	44,052	44,150	44,234	44,517 (8,903) [2,137] {1,068}	44,792 (8,958) [2,150] {1,075}	45,066 (9,013) [2,163] {1,082}
Saratoga	13,533	13,599	13,668	13,713	13,849 (2,770) [665] {332}	13,989 (2,798) [671] {336}	14,133 (2,827) [678] {339}
Schenectady	11,894	11,917	11,951	11,987	12,069 (2,414) [579] {290}	12,153 (2,431) [583] {292}	12,240 (2,448) [587] {294}
Suffolk	183,912	184,645	185,345	185,911	187,326 (37,465) [8,992] {4,496}	188,739 (37,748) [9,059] {4,530}	190,131 (38,026) [9,126] {4,563}
Sullivan	5,622	5,664	5,691	5,710	5,787 (1,157) [278] {139}	5,867 (1,173) [282] {141}	5,950 (1,190) [286] {143}
Tompkins	3,925	3,932	3,944	3,951	3,980 (796) [191] {96}	4,008 (802) [192] {96}	4,035 (807) [194] {97}
Ulster	12,126	12,205	12,271	12,322	12,471 (2,494) [599] {299}	12,620 (2,524) [606] {303}	12,767 (2,553) [613] {306}
Westchester	120,734	121,124	121,507	121,803	122,641 (24,528) [5,887] {2,943}	123,481 (24,696) [5,927] {2,964}	124,323 (24,865) [5,967] {2,984}

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.