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

Date: 1/12/21

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 1/12/21 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.

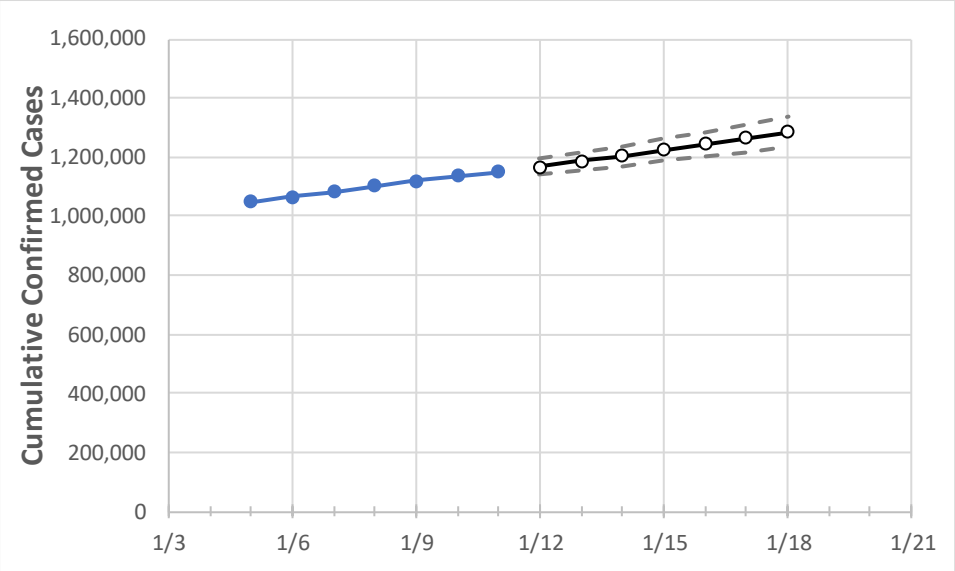
IEM's Modeling Lead

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:						
	1/8	1/9	1/10	1/11	1/12	1/13	1/14	1/15	1/16	1/17	1/18
New York	1,101,445	1,119,284	1,135,592	1,149,771	1,167,263	1,185,635	1,204,411	1,223,916	1,243,638	1,263,570	1,284,240

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:						
	1/8	1/9	1/10	1/11	1/12	1/13	1/14	1/15	1/16	1/17	1/18
Albany	13,697	13,930	14,196	14,411	14,682	14,956	15,236	15,515	15,804	16,100	16,387
Bronx	93,440	94,723	95,878	97,015	98,260	99,553	100,866	102,278	103,738	105,250	106,834
Dutchess	13,923	14,212	14,471	14,757	15,047	15,343	15,649	15,967	16,296	16,636	16,986
Erie	46,109	46,886	47,549	47,904	48,564	49,230	49,909	50,621	51,332	52,041	52,764
Kings	135,829	137,746	139,496	141,106	142,914	144,754	146,691	148,641	150,657	152,736	154,863
Monroe	38,849	39,555	40,293	40,693	41,323	41,949	42,585	43,220	43,868	44,522	45,180
Nassau	99,439	101,181	102,584	104,078	105,831	107,605	109,475	111,381	113,338	115,367	117,451
New York	66,790	67,692	68,604	69,504	70,369	71,253	72,156	73,094	74,058	75,038	76,059
Niagara	10,098	10,364	10,600	10,685	10,904	11,128	11,351	11,581	11,813	12,052	12,293
Onondaga	24,316	24,668	25,057	25,366	25,777	26,185	26,600	27,020	27,449	27,888	28,333
Orange	25,683	25,938	26,260	26,488	26,811	27,135	27,473	27,820	28,176	28,533	28,891
Putnam	5,551	5,645	5,750	5,844	5,954	6,068	6,186	6,307	6,431	6,558	6,688
Queens	138,603	140,744	142,648	144,291	146,325	148,412	150,564	152,811	155,119	157,470	159,924
Rensselaer	5,440	5,566	5,714	5,860	6,031	6,206	6,386	6,570	6,757	6,953	7,150
Richmond	39,412	40,109	40,659	41,122	41,744	42,390	43,052	43,739	44,439	45,167	45,899
Rockland	29,444	29,660	29,827	30,015	30,264	30,513	30,768	31,027	31,296	31,564	31,826
Saratoga	7,303	7,511	7,753	7,960	8,226	8,496	8,782	9,076	9,381	9,697	10,029
Schenectady	7,118	7,284	7,453	7,619	7,790	7,964	8,140	8,321	8,503	8,689	8,877
Suffolk	110,209	112,211	113,943	115,489	117,538	119,629	121,793	123,965	126,234	128,561	130,931
Sullivan	3,418	3,454	3,488	3,519	3,558	3,596	3,634	3,673	3,714	3,753	3,791
Tompkins	2,318	2,374	2,396	2,414	2,445	2,476	2,507	2,540	2,572	2,605	2,636
Ulster	6,557	6,677	6,835	6,927	7,057	7,192	7,328	7,470	7,616	7,768	7,924
Westchester	76,089	76,942	77,731	78,534	79,430	80,347	81,278	82,248	83,244	84,230	85,261

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:		
	1/8	1/9	1/10	1/11	1/13	1/15	1/17
Albany	13,697	13,930	14,196	14,411	14,956 (2,991) [718] {359}	15,515 (3,103) [745] {372}	16,100 (3,220) [773] {386}
Bronx	93,440	94,723	95,878	97,015	99,553 (19,911) [4,779] {2,389}	102,278 (20,456) [4,909] {2,455}	105,250 (21,050) [5,052] {2,526}
Dutchess	13,923	14,212	14,471	14,757	15,343 (3,069) [736] {368}	15,967 (3,193) [766] {383}	16,636 (3,327) [799] {399}
Erie	46,109	46,886	47,549	47,904	49,230 (9,846) [2,363] {1,182}	50,621 (10,124) [2,430] {1,215}	52,041 (10,408) [2,498] {1,249}
Kings	135,829	137,746	139,496	141,106	144,754 (28,951) [6,948] {3,474}	148,641 (29,728) [7,135] {3,567}	152,736 (30,547) [7,331] {3,666}
Monroe	38,849	39,555	40,293	40,693	41,949 (8,390) [2,014] {1,007}	43,220 (8,644) [2,075] {1,037}	44,522 (8,904) [2,137] {1,069}
Nassau	99,439	101,181	102,584	104,078	107,605 (21,521) [5,165] {2,583}	111,381 (22,276) [5,346] {2,673}	115,367 (23,073) [5,538] {2,769}
New York	66,790	67,692	68,604	69,504	71,253 (14,251) [3,420] {1,710}	73,094 (14,619) [3,509] {1,754}	75,038 (15,008) [3,602] {1,801}
Niagara	10,098	10,364	10,600	10,685	11,128 (2,226) [534] {267}	11,581 (2,316) [556] {278}	12,052 (2,410) [579] {289}
Onondaga	24,316	24,668	25,057	25,366	26,185 (5,237) [1,257] {628}	27,020 (5,404) [1,297] {648}	27,888 (5,578) [1,339] {669}
Orange	25,683	25,938	26,260	26,488	27,135 (5,427) [1,302] {651}	27,820 (5,564) [1,335] {668}	28,533 (5,707) [1,370] {685}
Putnam	5,551	5,645	5,750	5,844	6,068 (1,214) [291] {146}	6,307 (1,261) [303] {151}	6,558 (1,312) [315] {157}
Queens	138,603	140,744	142,648	144,291	148,412 (29,682) [7,124] {3,562}	152,811 (30,562) [7,335] {3,667}	157,470 (31,494) [7,559] {3,779}
Rensselaer	5,440	5,566	5,714	5,860	6,206 (1,241) [298] {149}	6,570 (1,314) [315] {158}	6,953 (1,391) [334] {167}
Richmond	39,412	40,109	40,659	41,122	42,390 (8,478) [2,035] {1,017}	43,739 (8,748) [2,099] {1,050}	45,167 (9,033) [2,168] {1,084}
Rockland	29,444	29,660	29,827	30,015	30,513 (6,103) [1,465] {732}	31,027 (6,205) [1,489] {745}	31,564 (6,313) [1,515] {758}
Saratoga	7,303	7,511	7,753	7,960	8,496 (1,699) [408] {204}	9,076 (1,815) [436] {218}	9,697 (1,939) [465] {233}
Schenectady	7,118	7,284	7,453	7,619	7,964 (1,593) [382] {191}	8,321 (1,664) [399] {200}	8,689 (1,738) [417] {209}
Suffolk	110,209	112,211	113,943	115,489	119,629 (23,926) [5,742] {2,871}	123,965 (24,793) [5,950] {2,975}	128,561 (25,712) [6,171] {3,085}
Sullivan	3,418	3,454	3,488	3,519	3,596 (719) [173] {86}	3,673 (735) [176] {88}	3,753 (751) [180] {90}
Tompkins	2,318	2,374	2,396	2,414	2,476 (495) [119] {59}	2,540 (508) [122] {61}	2,605 (521) [125] {63}
Ulster	6,557	6,677	6,835	6,927	7,192 (1,438) [345] {173}	7,470 (1,494) [359] {179}	7,768 (1,554) [373] {186}
Westchester	76,089	76,942	77,731	78,534	80,347 (16,069) [3,857] {1,928}	82,248 (16,450) [3,948] {1,974}	84,230 (16,846) [4,043] {2,022}

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.