IEM's AI Modeling: Short-term COVID-19 Projections
Date: 1/11/21

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 1/11/21 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
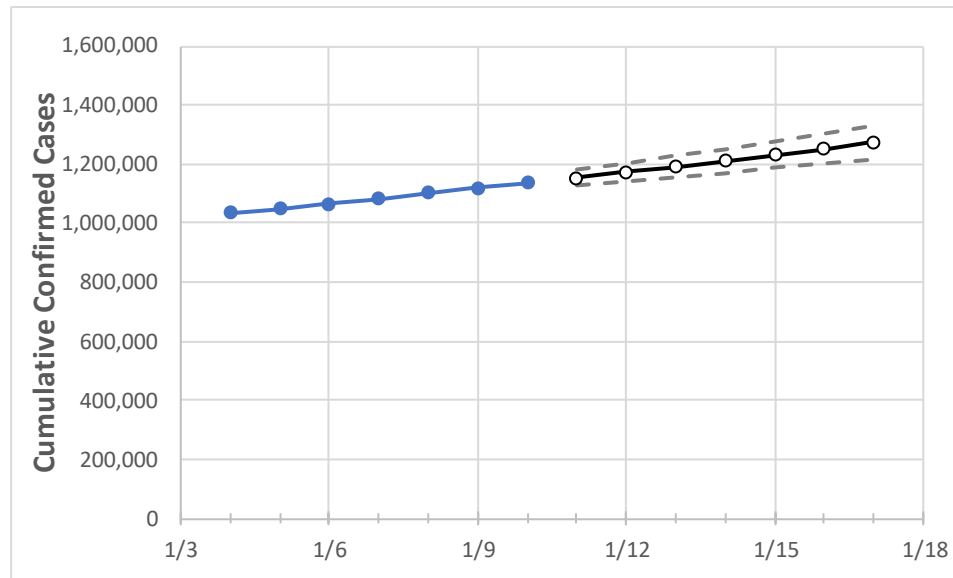
	Actual Confirmed Cases On:				Projected Cases For:						
	1/7	1/8	1/9	1/10	1/11	1/12	1/13	1/14	1/15	1/16	1/17
New York	1,081,885	1,101,445	1,119,284	1,135,592	1,153,717	1,172,225	1,191,762	1,211,511	1,231,763	1,252,472	1,273,797

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:						
	1/7	1/8	1/9	1/10	1/11	1/12	1/13	1/14	1/15	1/16	1/17
Albany	13,410	13,697	13,930	14,196	14,481	14,769	15,064	15,360	15,659	15,965	16,271
Bronx	92,156	93,440	94,723	95,878	97,105	98,384	99,716	101,090	102,530	104,018	105,561
Dutchess	13,642	13,923	14,212	14,471	14,748	15,035	15,330	15,632	15,945	16,275	16,614
Erie	45,077	46,109	46,886	47,549	48,195	48,884	49,566	50,282	51,001	51,738	52,511
Kings	133,865	135,829	137,746	139,496	141,344	143,277	145,266	147,297	149,433	151,611	153,877
Monroe	38,053	38,849	39,555	40,293	40,966	41,641	42,332	43,029	43,727	44,420	45,139
Nassau	97,746	99,439	101,181	102,584	104,351	106,137	108,004	109,920	111,859	113,879	115,978
New York	65,687	66,790	67,692	68,604	69,431	70,300	71,190	72,102	73,046	74,004	75,008
Niagara	9,806	10,098	10,364	10,600	10,836	11,078	11,330	11,590	11,854	12,130	12,409
Onondaga	23,764	24,316	24,668	25,057	25,479	25,898	26,326	26,748	27,196	27,621	28,060
Orange	25,254	25,683	25,938	26,260	26,592	26,937	27,288	27,656	28,031	28,414	28,807
Putnam	5,436	5,551	5,645	5,750	5,858	5,970	6,085	6,205	6,328	6,456	6,586
Queens	136,465	138,603	140,744	142,648	144,674	146,750	148,916	151,136	153,468	155,878	158,388
Rensselaer	5,249	5,440	5,566	5,714	5,880	6,051	6,226	6,409	6,595	6,788	6,991
Richmond	38,891	39,412	40,109	40,659	41,291	41,962	42,645	43,352	44,079	44,829	45,612
Rockland	29,202	29,444	29,660	29,827	30,078	30,334	30,599	30,865	31,134	31,408	31,687
Saratoga	7,027	7,303	7,511	7,753	8,016	8,297	8,580	8,876	9,179	9,493	9,828
Schenectady	6,952	7,118	7,284	7,453	7,622	7,792	7,965	8,143	8,324	8,509	8,692
Suffolk	108,255	110,209	112,211	113,943	116,071	118,244	120,510	122,813	125,184	127,626	130,103
Sullivan	3,370	3,418	3,454	3,488	3,528	3,568	3,608	3,647	3,687	3,727	3,769
Tompkins	2,278	2,318	2,374	2,396	2,427	2,459	2,491	2,524	2,556	2,591	2,624
Ulster	6,417	6,557	6,677	6,835	6,970	7,110	7,257	7,410	7,566	7,726	7,891
Westchester	75,176	76,089	76,942	77,731	78,641	79,570	80,524	81,484	82,460	83,471	84,499

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:		
	1/7	1/8	1/9	1/10	1/12	1/14	1/16
Albany	13,410	13,697	13,930	14,196	14,769 (2,954) [709] {354}	15,360 (3,072) [737] {369}	15,965 (3,193) [766] {383}
Bronx	92,156	93,440	94,723	95,878	98,384 (19,677) [4,722] {2,361}	101,090 (20,218) [4,852] {2,426}	104,018 (20,804) [4,993] {2,496}
Dutchess	13,642	13,923	14,212	14,471	15,035 (3,007) [722] {361}	15,632 (3,126) [750] {375}	16,275 (3,255) [781] {391}
Erie	45,077	46,109	46,886	47,549	48,884 (9,777) [2,346] {1,173}	50,282 (10,056) [2,414] {1,207}	51,738 (10,348) [2,483] {1,242}
Kings	133,865	135,829	137,746	139,496	143,277 (28,655) [6,877] {3,439}	147,297 (29,459) [7,070] {3,535}	151,611 (30,322) [7,277] {3,639}
Monroe	38,053	38,849	39,555	40,293	41,641 (8,328) [1,999] {999}	43,029 (8,606) [2,065] {1,033}	44,420 (8,884) [2,132] {1,066}
Nassau	97,746	99,439	101,181	102,584	106,137 (21,227) [5,095] {2,547}	109,920 (21,984) [5,276] {2,638}	113,879 (22,776) [5,466] {2,733}
New York	65,687	66,790	67,692	68,604	70,300 (14,060) [3,374] {1,687}	72,102 (14,420) [3,461] {1,730}	74,004 (14,801) [3,552] {1,776}
Niagara	9,806	10,098	10,364	10,600	11,078 (2,216) [532] {266}	11,590 (2,318) [556] {278}	12,130 (2,426) [582] {291}
Onondaga	23,764	24,316	24,668	25,057	25,898 (5,180) [1,243] {622}	26,748 (5,350) [1,284] {642}	27,621 (5,524) [1,326] {663}
Orange	25,254	25,683	25,938	26,260	26,937 (5,387) [1,293] {646}	27,656 (5,531) [1,327] {664}	28,414 (5,683) [1,364] {682}
Putnam	5,436	5,551	5,645	5,750	5,970 (1,194) [287] {143}	6,205 (1,241) [298] {149}	6,456 (1,291) [310] {155}
Queens	136,465	138,603	140,744	142,648	146,750 (29,350) [7,044] {3,522}	151,136 (30,227) [7,255] {3,627}	155,878 (31,176) [7,482] {3,741}
Rensselaer	5,249	5,440	5,566	5,714	6,051 (1,210) [290] {145}	6,409 (1,282) [308] {154}	6,788 (1,358) [326] {163}
Richmond	38,891	39,412	40,109	40,659	41,962 (8,392) [2,014] {1,007}	43,352 (8,670) [2,081] {1,040}	44,829 (8,966) [2,152] {1,076}
Rockland	29,202	29,444	29,660	29,827	30,334 (6,067) [1,456] {728}	30,865 (6,173) [1,482] {741}	31,408 (6,282) [1,508] {754}
Saratoga	7,027	7,303	7,511	7,753	8,297 (1,659) [398] {199}	8,876 (1,775) [426] {213}	9,493 (1,899) [456] {228}
Schenectady	6,952	7,118	7,284	7,453	7,792 (1,558) [374] {187}	8,143 (1,629) [391] {195}	8,509 (1,702) [408] {204}
Suffolk	108,255	110,209	112,211	113,943	118,244 (23,649) [5,676] {2,838}	122,813 (24,563) [5,895] {2,948}	127,626 (25,525) [6,126] {3,063}
Sullivan	3,370	3,418	3,454	3,488	3,568 (714) [171] {86}	3,647 (729) [175] {88}	3,727 (745) [179] {89}
Tompkins	2,278	2,318	2,374	2,396	2,459 (492) [118] {59}	2,524 (505) [121] {61}	2,591 (518) [124] {62}
Ulster	6,417	6,557	6,677	6,835	7,110 (1,422) [341] {171}	7,410 (1,482) [356] {178}	7,726 (1,545) [371] {185}
Westchester	75,176	76,089	76,942	77,731	79,570 (15,914) [3,819] {1,910}	81,484 (16,297) [3,911] {1,956}	83,471 (16,694) [4,007] {2,003}

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.