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

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 1/21/21 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
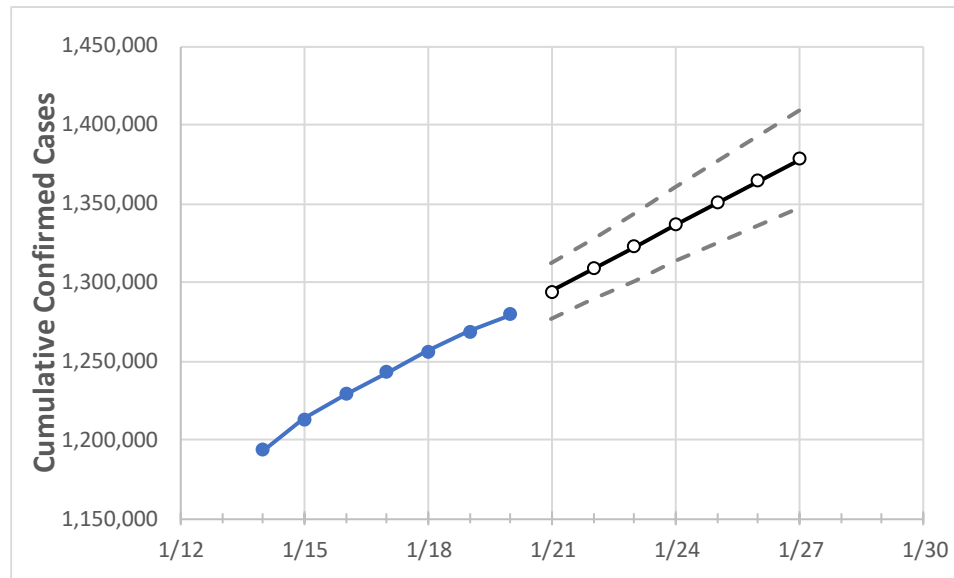
	Actual Confirmed Cases On:				Projected Cases For:						
	1/17	1/18	1/19	1/20	1/21	1/22	1/23	1/24	1/25	1/26	1/27
New York	1,242,561	1,255,971	1,268,692	1,279,811	1,294,348	1,308,600	1,322,827	1,336,781	1,350,600	1,364,437	1,378,234

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:						
	1/17	1/18	1/19	1/20	1/21	1/22	1/23	1/24	1/25	1/26	1/27
Albany	15,981	16,168	16,343	16,521	16,740	16,957	17,174	17,389	17,603	17,816	18,026
Bronx	103,869	105,175	106,253	106,955	108,151	109,371	110,612	111,858	113,127	114,415	115,700
Dutchess	16,327	16,541	16,757	16,963	17,219	17,474	17,733	17,990	18,248	18,506	18,766
Erie	51,384	51,718	52,228	52,473	53,039	53,587	54,138	54,695	55,227	55,773	56,331
Kings	151,971	153,838	155,509	156,873	158,717	160,575	162,434	164,314	166,202	168,110	170,019
Monroe	43,659	44,007	44,318	44,631	45,070	45,500	45,925	46,338	46,739	47,129	47,514
Nassau	112,702	113,812	114,969	116,065	117,381	118,668	119,934	121,192	122,423	123,647	124,857
New York	74,452	75,319	75,965	76,546	77,456	78,379	79,337	80,288	81,253	82,231	83,224
Niagara	11,822	11,933	12,143	12,229	12,397	12,559	12,723	12,881	13,045	13,215	13,368
Onondaga	27,190	27,492	27,755	27,948	28,236	28,515	28,794	29,072	29,338	29,599	29,858
Orange	28,386	28,574	28,848	29,078	29,378	29,674	29,976	30,278	30,582	30,880	31,178
Putnam	6,386	6,447	6,521	6,576	6,661	6,742	6,826	6,908	6,990	7,074	7,157
Queens	155,059	156,940	158,683	160,018	161,885	163,770	165,690	167,596	169,497	171,432	173,347
Rensselaer	6,693	6,772	6,874	6,965	7,087	7,207	7,328	7,447	7,565	7,684	7,796
Richmond	44,210	44,737	45,156	45,516	46,002	46,481	46,954	47,435	47,901	48,366	48,826
Rockland	31,509	31,668	31,884	32,137	32,368	32,607	32,843	33,083	33,325	33,566	33,808
Saratoga	8,984	9,140	9,267	9,375	9,527	9,679	9,824	9,968	10,106	10,244	10,378
Schenectady	8,480	8,587	8,660	8,770	8,901	9,029	9,155	9,278	9,400	9,521	9,640
Suffolk	125,925	127,287	128,580	129,804	131,346	132,880	134,391	135,869	137,370	138,820	140,247
Sullivan	3,765	3,798	3,841	3,887	3,927	3,967	4,008	4,048	4,089	4,130	4,171
Tompkins	2,613	2,641	2,657	2,707	2,742	2,778	2,815	2,852	2,889	2,926	2,964
Ulster	7,548	7,642	7,745	7,822	7,933	8,044	8,156	8,270	8,385	8,499	8,616
Westchester	83,708	84,420	85,020	85,723	86,518	87,318	88,113	88,906	89,695	90,487	91,269

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:		
	1/17	1/18	1/19	1/20	1/22	1/24	1/26
Albany	15,981	16,168	16,343	16,521	16,957 (3,391) [814] {407}	17,389 (3,478) [835] {417}	17,816 (3,563) [855] {428}
Bronx	103,869	105,175	106,253	106,955	109,371 (21,874) [5,250] {2,625}	111,858 (22,372) [5,369] {2,685}	114,415 (22,883) [5,492] {2,746}
Dutchess	16,327	16,541	16,757	16,963	17,474 (3,495) [839] {419}	17,990 (3,598) [864] {432}	18,506 (3,701) [888] {444}
Erie	51,384	51,718	52,228	52,473	53,587 (10,717) [2,572] {1,286}	54,695 (10,939) [2,625] {1,313}	55,773 (11,155) [2,677] {1,339}
Kings	151,971	153,838	155,509	156,873	160,575 (32,115) [7,708] {3,854}	164,314 (32,863) [7,887] {3,944}	168,110 (33,622) [8,069] {4,035}
Monroe	43,659	44,007	44,318	44,631	45,500 (9,100) [2,184] {1,092}	46,338 (9,268) [2,224] {1,112}	47,129 (9,426) [2,262] {1,131}
Nassau	112,702	113,812	114,969	116,065	118,668 (23,734) [5,696] {2,848}	121,192 (24,238) [5,817] {2,909}	123,647 (24,729) [5,935] {2,968}
New York	74,452	75,319	75,965	76,546	78,379 (15,676) [3,762] {1,881}	80,288 (16,058) [3,854] {1,927}	82,231 (16,446) [3,947] {1,974}
Niagara	11,822	11,933	12,143	12,229	12,559 (2,512) [603] {301}	12,881 (2,576) [618] {309}	13,215 (2,643) [634] {317}
Onondaga	27,190	27,492	27,755	27,948	28,515 (5,703) [1,369] {684}	29,072 (5,814) [1,395] {698}	29,599 (5,920) [1,421] {710}
Orange	28,386	28,574	28,848	29,078	29,674 (5,935) [1,424] {712}	30,278 (6,056) [1,453] {727}	30,880 (6,176) [1,482] {741}
Putnam	6,386	6,447	6,521	6,576	6,742 (1,348) [324] {162}	6,908 (1,382) [332] {166}	7,074 (1,415) [340] {170}
Queens	155,059	156,940	158,683	160,018	163,770 (32,754) [7,861] {3,930}	167,596 (33,519) [8,045] {4,022}	171,432 (34,286) [8,229] {4,114}
Rensselaer	6,693	6,772	6,874	6,965	7,207 (1,441) [346] {173}	7,447 (1,489) [357] {179}	7,684 (1,537) [369] {184}
Richmond	44,210	44,737	45,156	45,516	46,481 (9,296) [2,231] {1,116}	47,435 (9,487) [2,277] {1,138}	48,366 (9,673) [2,322] {1,161}
Rockland	31,509	31,668	31,884	32,137	32,607 (6,521) [1,565] {783}	33,083 (6,617) [1,588] {794}	33,566 (6,713) [1,611] {806}
Saratoga	8,984	9,140	9,267	9,375	9,679 (1,936) [465] {232}	9,968 (1,994) [478] {239}	10,244 (2,049) [492] {246}
Schenectady	8,480	8,587	8,660	8,770	9,029 (1,806) [433] {217}	9,278 (1,856) [445] {223}	9,521 (1,904) [457] {229}
Suffolk	125,925	127,287	128,580	129,804	132,880 (26,576) [6,378] {3,189}	135,869 (27,174) [6,522] {3,261}	138,820 (27,764) [6,663] {3,332}
Sullivan	3,765	3,798	3,841	3,887	3,967 (793) [190] {95}	4,048 (810) [194] {97}	4,130 (826) [198] {99}
Tompkins	2,613	2,641	2,657	2,707	2,778 (556) [133] {67}	2,852 (570) [137] {68}	2,926 (585) [140] {70}
Ulster	7,548	7,642	7,745	7,822	8,044 (1,609) [386] {193}	8,270 (1,654) [397] {198}	8,499 (1,700) [408] {204}
Westchester	83,708	84,420	85,020	85,723	87,318 (17,464) [4,191] {2,096}	88,906 (17,781) [4,267] {2,134}	90,487 (18,097) [4,343] {2,172}

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.