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

Date: 1/10/22

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 1/10/22 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.

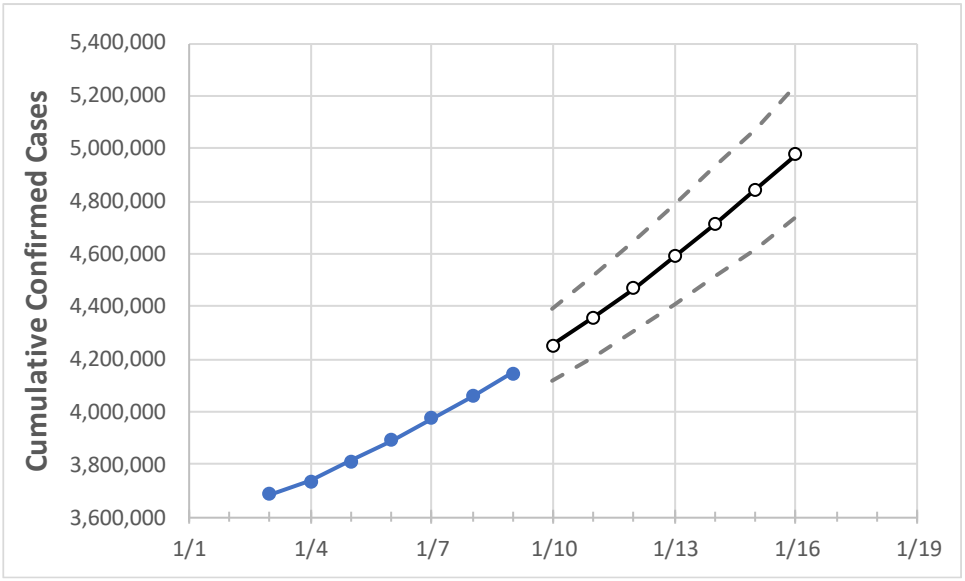
IEM's Modeling Lead

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:						
	1/6	1/7	1/8	1/9	1/10	1/11	1/12	1/13	1/14	1/15	1/16
New York	3,890,666	3,975,745	4,057,133	4,147,154	4,251,602	4,357,135	4,470,116	4,589,606	4,712,645	4,845,651	4,977,047

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:						
	1/6	1/7	1/8	1/9	1/10	1/11	1/12	1/13	1/14	1/15	1/16
Albany	44,357	45,231	46,262	46,933	47,745	48,621	49,525	50,454	51,442	52,495	53,597
Bronx	316,241	326,177	327,901	343,370	356,492	370,535	385,203	401,190	418,353	436,357	454,957
Dutchess	50,003	51,105	52,215	53,157	54,226	55,328	56,476	57,695	58,980	60,345	61,736
Erie	161,690	165,133	168,530	171,021	174,279	177,695	181,370	185,199	189,227	193,440	197,956
Kings	535,325	550,087	561,078	574,741	593,291	611,982	631,994	652,664	675,102	698,684	722,927
Monroe	121,594	123,692	125,927	127,632	129,597	131,649	133,845	136,172	138,624	141,165	143,872
Nassau	330,870	336,980	343,597	350,265	358,696	367,510	376,562	385,944	395,715	406,052	416,527
New York	312,248	319,550	328,312	335,225	344,666	354,257	364,279	374,479	385,005	396,164	407,604
Niagara	37,272	37,879	38,617	39,167	39,821	40,505	41,213	41,973	42,769	43,596	44,456
Onondaga	78,104	80,188	82,087	83,866	85,755	87,769	89,858	92,122	94,497	97,006	99,692
Orange	84,287	85,753	87,890	89,570	91,589	93,669	95,855	98,131	100,541	103,080	105,725
Putnam	18,882	19,290	19,693	20,016	20,526	21,045	21,588	22,147	22,733	23,358	24,005
Queens	487,902	500,152	515,355	528,902	547,368	566,595	586,792	608,604	631,268	655,543	681,048
Rensselaer	22,852	23,354	23,915	24,329	24,770	25,231	25,710	26,219	26,748	27,310	27,897
Richmond	133,313	136,323	138,490	141,783	145,891	150,093	154,546	159,207	164,171	169,291	174,607
Rockland	74,264	75,775	77,349	78,478	80,437	82,486	84,650	86,947	89,367	91,927	94,640
Saratoga	33,850	34,555	35,300	35,955	36,646	37,365	38,112	38,889	39,725	40,586	41,475
Schenectady	24,442	24,963	25,456	25,976	26,459	26,971	27,508	28,087	28,692	29,323	29,983
Suffolk	354,277	359,671	366,663	373,459	380,879	388,556	396,555	404,770	413,421	422,288	431,436
Sullivan	13,722	14,026	14,441	14,756	15,112	15,496	15,899	16,312	16,756	17,206	17,688
Tompkins	12,531	12,813	13,097	13,387	13,546	13,704	13,863	14,024	14,171	14,339	14,494
Ulster	23,967	24,346	24,817	25,225	25,639	26,078	26,537	27,026	27,539	28,069	28,641
Westchester	203,075	207,055	211,487	215,425	220,368	225,480	230,834	236,519	242,395	248,570	255,196

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:		
	1/6	1/7	1/8	1/9	1/11	1/13	1/15
Albany	44,357	45,231	46,262	46,933	48,621 (9,724) [2,334] {1,167}	50,454 (10,091) [2,422] {1,211}	52,495 (10,499) [2,520] {1,260}
Bronx	316,241	326,177	327,901	343,370	370,535 (74,107) [17,786] {8,893}	401,190 (80,238) [19,257] {9,629}	436,357 (87,271) [20,945] {10,473}
Dutchess	50,003	51,105	52,215	53,157	55,328 (11,066) [2,656] {1,328}	57,695 (11,539) [2,769] {1,385}	60,345 (12,069) [2,897] {1,448}
Erie	161,690	165,133	168,530	171,021	177,695 (35,539) [8,529] {4,265}	185,199 (37,040) [8,890] {4,445}	193,440 (38,688) [9,285] {4,643}
Kings	535,325	550,087	561,078	574,741	611,982 (122,396) [29,375] {14,688}	652,664 (130,533) [31,328] {15,664}	698,684 (139,737) [33,537] {16,768}
Monroe	121,594	123,692	125,927	127,632	131,649 (26,330) [6,319] {3,160}	136,172 (27,234) [6,536] {3,268}	141,165 (28,233) [6,776] {3,388}
Nassau	330,870	336,980	343,597	350,265	367,510 (73,502) [17,640] {8,820}	385,944 (77,189) [18,525] {9,263}	406,052 (81,210) [19,490] {9,745}
New York	312,248	319,550	328,312	335,225	354,257 (70,851) [17,004] {8,502}	374,479 (74,896) [17,975] {8,987}	396,164 (79,233) [19,016] {9,508}
Niagara	37,272	37,879	38,617	39,167	40,505 (8,101) [1,944] {972}	41,973 (8,395) [2,015] {1,007}	43,596 (8,719) [2,093] {1,046}
Onondaga	78,104	80,188	82,087	83,866	87,769 (17,554) [4,213] {2,106}	92,122 (18,424) [4,422] {2,211}	97,006 (19,401) [4,656] {2,328}
Orange	84,287	85,753	87,890	89,570	93,669 (18,734) [4,496] {2,248}	98,131 (19,626) [4,710] {2,355}	103,080 (20,616) [4,948] {2,474}
Putnam	18,882	19,290	19,693	20,016	21,045 (4,209) [1,010] {505}	22,147 (4,429) [1,063] {532}	23,358 (4,672) [1,121] {561}
Queens	487,902	500,152	515,355	528,902	566,595 (113,319) [27,197] {13,598}	608,604 (121,721) [29,213] {14,606}	655,543 (131,109) [31,466] {15,733}
Rensselaer	22,852	23,354	23,915	24,329	25,231 (5,046) [1,211] {606}	26,219 (5,244) [1,259] {629}	27,310 (5,462) [1,311] {655}
Richmond	133,313	136,323	138,490	141,783	150,093 (30,019) [7,204] {3,602}	159,207 (31,841) [7,642] {3,821}	169,291 (33,858) [8,126] {4,063}
Rockland	74,264	75,775	77,349	78,478	82,486 (16,497) [3,959] {1,980}	86,947 (17,389) [4,173] {2,087}	91,927 (18,385) [4,413] {2,206}
Saratoga	33,850	34,555	35,300	35,955	37,365 (7,473) [1,794] {897}	38,889 (7,778) [1,867] {933}	40,586 (8,117) [1,948] {974}
Schenectady	24,442	24,963	25,456	25,976	26,971 (5,394) [1,295] {647}	28,087 (5,617) [1,348] {674}	29,323 (5,865) [1,408] {704}
Suffolk	354,277	359,671	366,663	373,459	388,556 (77,711) [18,651] {9,325}	404,770 (80,954) [19,429] {9,714}	422,288 (84,458) [20,270] {10,135}
Sullivan	13,722	14,026	14,441	14,756	15,496 (3,099) [744] {372}	16,312 (3,262) [783] {391}	17,206 (3,441) [826] {413}
Tompkins	12,531	12,813	13,097	13,387	13,704 (2,741) [658] {329}	14,024 (2,805) [673] {337}	14,339 (2,868) [688] {344}
Ulster	23,967	24,346	24,817	25,225	26,078 (5,216) [1,252] {626}	27,026 (5,405) [1,297] {649}	28,069 (5,614) [1,347] {674}
Westchester	203,075	207,055	211,487	215,425	225,480 (45,096) [10,823] {5,412}	236,519 (47,304) [11,353] {5,676}	248,570 (49,714) [11,931] {5,966}

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.