IEM's AI Modeling: Short-term COVID-19 Projections
Date: 1/14/21

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 <u>not</u> 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 1/14/21 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
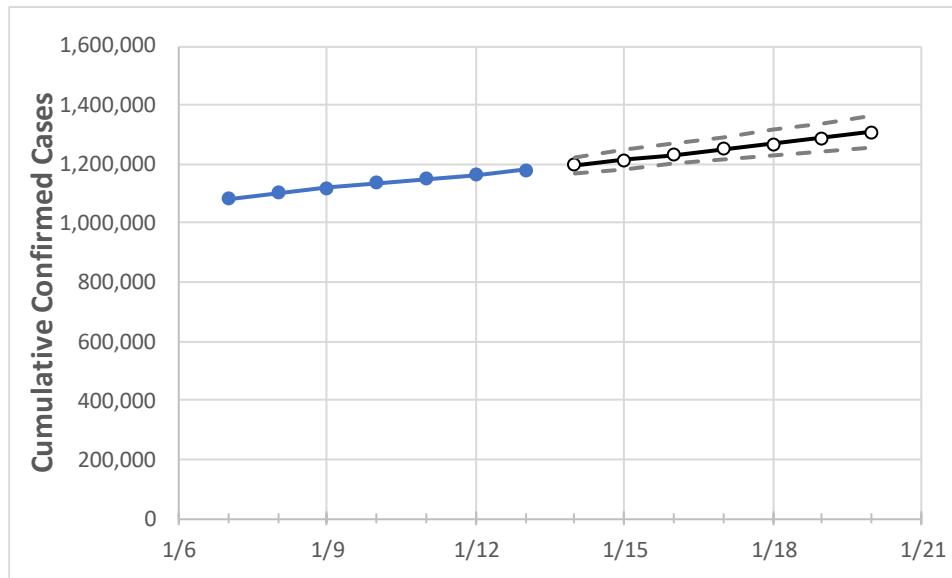
	Actual Confirmed Cases On:				Projected Cases For:						
	1/10	1/11	1/12	1/13	1/14	1/15	1/16	1/17	1/18	1/19	1/20
New York	1,135,592	1,149,771	1,164,562	1,179,266	1,196,425	1,214,336	1,232,094	1,250,378	1,269,206	1,287,987	1,307,249

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.

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New York Counties

	Actual Confirmed Cases On:				Projected Cases For:						
	1/10	1/11	1/12	1/13	1/14	1/15	1/16	1/17	1/18	1/19	1/20
Albany	14,196	14,411	14,763	14,974	15,253	15,534	15,819	16,104	16,386	16,677	16,966
Bronx	95,878	97,015	98,058	99,088	100,363	101,651	103,011	104,409	105,819	107,261	108,760
Dutchess	14,471	14,757	14,997	15,270	15,562	15,858	16,162	16,476	16,797	17,125	17,462
Erie	47,549	47,904	48,454	48,982	49,615	50,259	50,920	51,583	52,256	52,930	53,623
Kings	139,496	141,106	142,754	144,589	146,492	148,406	150,363	152,370	154,423	156,516	158,689
Monroe	40,293	40,693	41,157	41,644	42,234	42,812	43,412	43,983	44,557	45,139	45,715
Nassau	102,584	104,078	105,497	106,954	108,649	110,366	112,142	113,949	115,790	117,670	119,568
New York	68,604	69,504	70,193	70,882	71,751	72,643	73,556	74,483	75,443	76,409	77,408
Niagara	10,600	10,685	10,888	11,075	11,292	11,521	11,749	11,981	12,219	12,462	12,709
Onondaga	25,057	25,366	25,626	25,855	26,226	26,590	26,960	27,341	27,701	28,078	28,453
Orange	26,260	26,488	26,787	27,160	27,501	27,842	28,195	28,555	28,917	29,298	29,662
Putnam	5,750	5,844	5,930	6,014	6,120	6,229	6,340	6,453	6,568	6,686	6,807
Queens	142,648	144,291	145,897	147,779	149,808	151,863	154,000	156,182	158,420	160,703	163,057
Rensselaer	5,714	5,860	6,040	6,117	6,276	6,440	6,607	6,776	6,948	7,124	7,304
Richmond	40,659	41,122	41,711	42,223	42,850	43,496	44,156	44,823	45,506	46,211	46,928
Rockland	29,827	30,015	30,273	30,557	30,809	31,068	31,327	31,585	31,850	32,116	32,393
Saratoga	7,753	7,960	8,124	8,226	8,454	8,691	8,934	9,181	9,436	9,692	9,953
Schenectady	7,453	7,619	7,759	7,879	8,038	8,199	8,358	8,520	8,684	8,846	9,011
Suffolk	113,943	115,489	117,156	118,829	120,814	122,833	124,862	126,903	128,994	131,116	133,261
Sullivan	3,488	3,519	3,570	3,614	3,654	3,694	3,735	3,776	3,817	3,858	3,900
Tompkins	2,396	2,414	2,424	2,463	2,493	2,523	2,553	2,583	2,613	2,644	2,674
Ulster	6,835	6,927	7,038	7,107	7,234	7,361	7,491	7,625	7,759	7,897	8,038
Westchester	77,731	78,534	79,406	80,146	81,046	81,960	82,882	83,831	84,792	85,769	86,751

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:		
	1/10	1/11	1/12	1/13	1/15	1/17	1/19
Albany	14,196	14,411	14,763	14,974	15,534 (3,107) [746] {373}	16,104 (3,221) [773] {386}	16,677 (3,335) [800] {400}
Bronx	95,878	97,015	98,058	99,088	101,651 (20,330) [4,879] {2,440}	104,409 (20,882) [5,012] {2,506}	107,261 (21,452) [5,149] {2,574}
Dutchess	14,471	14,757	14,997	15,270	15,858 (3,172) [761] {381}	16,476 (3,295) [791] {395}	17,125 (3,425) [822] {411}
Erie	47,549	47,904	48,454	48,982	50,259 (10,052) [2,412] {1,206}	51,583 (10,317) [2,476] {1,238}	52,930 (10,586) [2,541] {1,270}
Kings	139,496	141,106	142,754	144,589	148,406 (29,681) [7,123] {3,562}	152,370 (30,474) [7,314] {3,657}	156,516 (31,303) [7,513] {3,756}
Monroe	40,293	40,693	41,157	41,644	42,812 (8,562) [2,055] {1,027}	43,983 (8,797) [2,111] {1,056}	45,139 (9,028) [2,167] {1,083}
Nassau	102,584	104,078	105,497	106,954	110,366 (22,073) [5,298] {2,649}	113,949 (22,790) [5,470] {2,735}	117,670 (23,534) [5,648] {2,824}
New York	68,604	69,504	70,193	70,882	72,643 (14,529) [3,487] {1,743}	74,483 (14,897) [3,575] {1,788}	76,409 (15,282) [3,668] {1,834}
Niagara	10,600	10,685	10,888	11,075	11,521 (2,304) [553] {277}	11,981 (2,396) [575] {288}	12,462 (2,492) [598] {299}
Onondaga	25,057	25,366	25,626	25,855	26,590 (5,318) [1,276] {638}	27,341 (5,468) [1,312] {656}	28,078 (5,616) [1,348] {674}
Orange	26,260	26,488	26,787	27,160	27,842 (5,568) [1,336] {668}	28,555 (5,711) [1,371] {685}	29,298 (5,860) [1,406] {703}
Putnam	5,750	5,844	5,930	6,014	6,229 (1,246) [299] {149}	6,453 (1,291) [310] {155}	6,686 (1,337) [321] {160}
Queens	142,648	144,291	145,897	147,779	151,863 (30,373) [7,289] {3,645}	156,182 (31,236) [7,497] {3,748}	160,703 (32,141) [7,714] {3,857}
Rensselaer	5,714	5,860	6,040	6,117	6,440 (1,288) [309] {155}	6,776 (1,355) [325] {163}	7,124 (1,425) [342] {171}
Richmond	40,659	41,122	41,711	42,223	43,496 (8,699) [2,088] {1,044}	44,823 (8,965) [2,151] {1,076}	46,211 (9,242) [2,218] {1,109}
Rockland	29,827	30,015	30,273	30,557	31,068 (6,214) [1,491] {746}	31,585 (6,317) [1,516] {758}	32,116 (6,423) [1,542] {771}
Saratoga	7,753	7,960	8,124	8,226	8,691 (1,738) [417] {209}	9,181 (1,836) [441] {220}	9,692 (1,938) [465] {233}
Schenectady	7,453	7,619	7,759	7,879	8,199 (1,640) [394] {197}	8,520 (1,704) [409] {204}	8,846 (1,769) [425] {212}
Suffolk	113,943	115,489	117,156	118,829	122,833 (24,567) [5,896] {2,948}	126,903 (25,381) [6,091] {3,046}	131,116 (26,223) [6,294] {3,147}
Sullivan	3,488	3,519	3,570	3,614	3,694 (739) [177] {89}	3,776 (755) [181] {91}	3,858 (772) [185] {93}
Tompkins	2,396	2,414	2,424	2,463	2,523 (505) [121] {61}	2,583 (517) [124] {62}	2,644 (529) [127] {63}
Ulster	6,835	6,927	7,038	7,107	7,361 (1,472) [353] {177}	7,625 (1,525) [366] {183}	7,897 (1,579) [379] {190}
Westchester	77,731	78,534	79,406	80,146	81,960 (16,392) [3,934] {1,967}	83,831 (16,766) [4,024] {2,012}	85,769 (17,154) [4,117] {2,058}

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.