IEM's AI Modeling: Short-term COVID-19 Projections
Date: 1/6/21

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 1/6/21 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
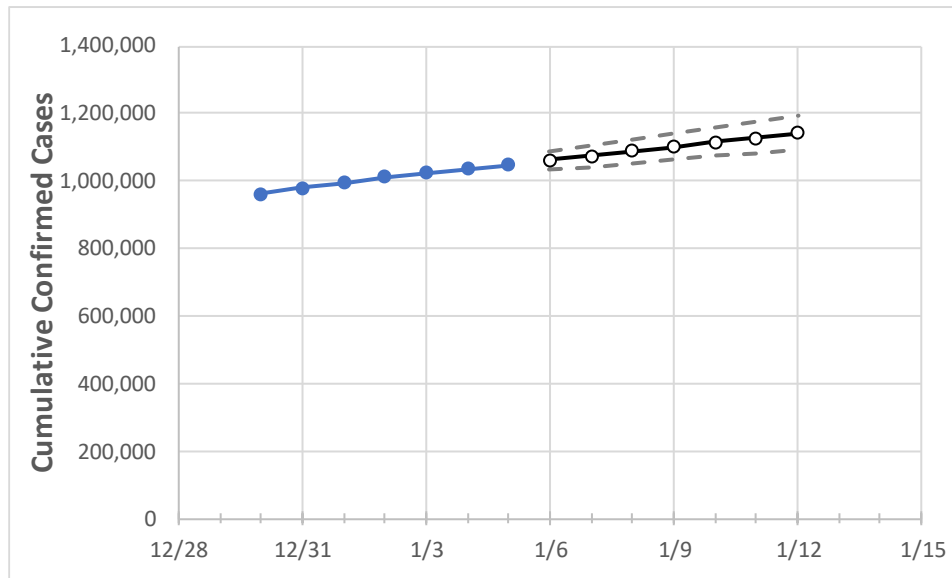
	Actual Confirmed Cases On:				Projected Cases For:						
	1/2	1/3	1/4	1/5	1/6	1/7	1/8	1/9	1/10	1/11	1/12
New York	1,011,665	1,023,897	1,035,139	1,048,281	1,061,510	1,074,789	1,088,160	1,101,671	1,115,341	1,128,826	1,142,793

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:						
	1/2	1/3	1/4	1/5	1/6	1/7	1/8	1/9	1/10	1/11	1/12
Albany	12,199	12,405	12,593	12,852	13,115	13,381	13,648	13,919	14,197	14,482	14,766
Bronx	87,727	88,526	89,197	90,121	90,901	91,702	92,498	93,317	94,153	94,975	95,837
Dutchess	12,601	12,797	13,020	13,190	13,400	13,615	13,833	14,052	14,277	14,504	14,729
Erie	42,465	42,933	43,442	43,816	44,263	44,715	45,144	45,587	46,035	46,460	46,893
Kings	127,067	128,248	129,252	130,653	131,947	133,249	134,540	135,864	137,221	138,601	139,962
Monroe	35,214	35,778	36,258	36,705	37,248	37,794	38,348	38,894	39,440	39,981	40,517
Nassau	90,869	92,035	93,106	94,379	95,708	97,083	98,465	99,896	101,360	102,818	104,354
New York	62,494	62,989	63,434	64,189	64,770	65,362	65,955	66,556	67,169	67,767	68,380
Niagara	8,901	9,083	9,259	9,393	9,559	9,727	9,900	10,074	10,253	10,428	10,606
Onondaga	21,926	22,213	22,697	22,880	23,211	23,539	23,866	24,193	24,521	24,848	25,177
Orange	24,033	24,197	24,370	24,579	24,820	25,063	25,309	25,560	25,806	26,053	26,311
Putnam	5,025	5,084	5,162	5,235	5,313	5,391	5,472	5,551	5,633	5,718	5,803
Queens	128,917	130,228	131,464	133,083	134,516	135,954	137,412	138,911	140,418	141,983	143,556
Rensselaer	4,575	4,724	4,796	4,933	5,070	5,209	5,354	5,503	5,658	5,814	5,974
Richmond	36,221	36,639	37,042	37,680	38,132	38,591	39,055	39,539	40,019	40,526	41,041
Rockland	28,011	28,162	28,335	28,568	28,793	29,021	29,246	29,475	29,704	29,941	30,175
Saratoga	6,060	6,243	6,360	6,543	6,738	6,937	7,144	7,354	7,570	7,793	8,024
Schenectady	6,229	6,369	6,501	6,619	6,770	6,923	7,077	7,232	7,393	7,555	7,717
Suffolk	99,717	101,233	102,465	104,019	105,569	107,149	108,745	110,379	112,045	113,719	115,444
Sullivan	3,218	3,227	3,249	3,276	3,317	3,357	3,399	3,443	3,484	3,527	3,572
Tompkins	2,133	2,138	2,152	2,166	2,186	2,207	2,227	2,248	2,268	2,288	2,307
Ulster	5,935	6,019	6,089	6,186	6,279	6,372	6,466	6,564	6,659	6,756	6,859
Westchester	71,627	72,218	72,762	73,381	74,075	74,768	75,483	76,208	76,920	77,636	78,387

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:		
	1/2	1/3	1/4	1/5	1/7	1/9	1/11
Albany	12,199	12,405	12,593	12,852	13,381 (2,676) [642] {321}	13,919 (2,784) [668] {334}	14,482 (2,896) [695] {348}
Bronx	87,727	88,526	89,197	90,121	91,702 (18,340) [4,402] {2,201}	93,317 (18,663) [4,479] {2,240}	94,975 (18,995) [4,559] {2,279}
Dutchess	12,601	12,797	13,020	13,190	13,615 (2,723) [654] {327}	14,052 (2,810) [675] {337}	14,504 (2,901) [696] {348}
Erie	42,465	42,933	43,442	43,816	44,715 (8,943) [2,146] {1,073}	45,587 (9,117) [2,188] {1,094}	46,460 (9,292) [2,230] {1,115}
Kings	127,067	128,248	129,252	130,653	133,249 (26,650) [6,396] {3,198}	135,864 (27,173) [6,521] {3,261}	138,601 (27,720) [6,653] {3,326}
Monroe	35,214	35,778	36,258	36,705	37,794 (7,559) [1,814] {907}	38,894 (7,779) [1,867] {933}	39,981 (7,996) [1,919] {960}
Nassau	90,869	92,035	93,106	94,379	97,083 (19,417) [4,660] {2,330}	99,896 (19,979) [4,795] {2,397}	102,818 (20,564) [4,935] {2,468}
New York	62,494	62,989	63,434	64,189	65,362 (13,072) [3,137] {1,569}	66,556 (13,311) [3,195] {1,597}	67,767 (13,553) [3,253] {1,626}
Niagara	8,901	9,083	9,259	9,393	9,727 (1,945) [467] {233}	10,074 (2,015) [484] {242}	10,428 (2,086) [501] {250}
Onondaga	21,926	22,213	22,697	22,880	23,539 (4,708) [1,130] {565}	24,193 (4,839) [1,161] {581}	24,848 (4,970) [1,193] {596}
Orange	24,033	24,197	24,370	24,579	25,063 (5,013) [1,203] {602}	25,560 (5,112) [1,227] {613}	26,053 (5,211) [1,251] {625}
Putnam	5,025	5,084	5,162	5,235	5,391 (1,078) [259] {129}	5,551 (1,110) [266] {133}	5,718 (1,144) [274] {137}
Queens	128,917	130,228	131,464	133,083	135,954 (27,191) [6,526] {3,263}	138,911 (27,782) [6,668] {3,334}	141,983 (28,397) [6,815] {3,408}
Rensselaer	4,575	4,724	4,796	4,933	5,209 (1,042) [250] {125}	5,503 (1,101) [264] {132}	5,814 (1,163) [279] {140}
Richmond	36,221	36,639	37,042	37,680	38,591 (7,718) [1,852] {926}	39,539 (7,908) [1,898] {949}	40,526 (8,105) [1,945] {973}
Rockland	28,011	28,162	28,335	28,568	29,021 (5,804) [1,393] {696}	29,475 (5,895) [1,415] {707}	29,941 (5,988) [1,437] {719}
Saratoga	6,060	6,243	6,360	6,543	6,937 (1,387) [333] {166}	7,354 (1,471) [353] {176}	7,793 (1,559) [374] {187}
Schenectady	6,229	6,369	6,501	6,619	6,923 (1,385) [332] {166}	7,232 (1,446) [347] {174}	7,555 (1,511) [363] {181}
Suffolk	99,717	101,233	102,465	104,019	107,149 (21,430) [5,143] {2,572}	110,379 (22,076) [5,298] {2,649}	113,719 (22,744) [5,458] {2,729}
Sullivan	3,218	3,227	3,249	3,276	3,357 (671) [161] {81}	3,443 (689) [165] {83}	3,527 (705) [169] {85}
Tompkins	2,133	2,138	2,152	2,166	2,207 (441) [106] {53}	2,248 (450) [108] {54}	2,288 (458) [110] {55}
Ulster	5,935	6,019	6,089	6,186	6,372 (1,274) [306] {153}	6,564 (1,313) [315] {158}	6,756 (1,351) [324] {162}
Westchester	71,627	72,218	72,762	73,381	74,768 (14,954) [3,589] {1,794}	76,208 (15,242) [3,658] {1,829}	77,636 (15,527) [3,727] {1,863}

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.