IEM's AI Modeling: Short-term COVID-19 Projections
Date: 1/5/21

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 1/5/21 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
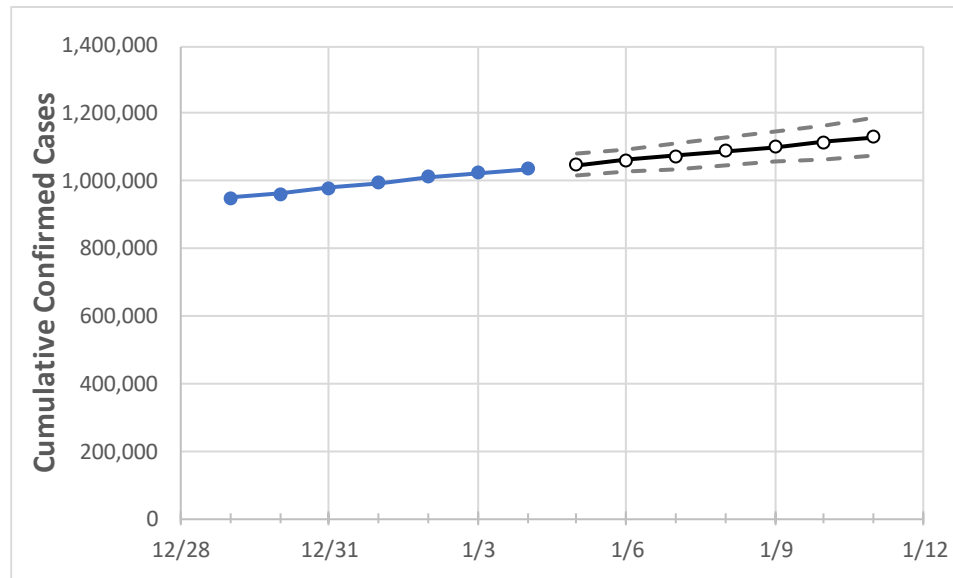
	Actual Confirmed Cases On:				Projected Cases For:						
	1/1	1/2	1/3	1/4	1/5	1/6	1/7	1/8	1/9	1/10	1/11
New York	995,816	1,011,665	1,023,897	1,035,139	1,047,928	1,061,120	1,074,618	1,088,104	1,101,853	1,115,675	1,129,891

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:						
	1/1	1/2	1/3	1/4	1/5	1/6	1/7	1/8	1/9	1/10	1/11
Albany	11,917	12,199	12,405	12,593	12,847	13,111	13,374	13,638	13,902	14,170	14,445
Bronx	86,505	87,727	88,526	89,197	89,980	90,764	91,547	92,341	93,149	93,969	94,802
Dutchess	12,379	12,601	12,797	13,020	13,237	13,456	13,679	13,908	14,139	14,377	14,618
Erie	41,988	42,465	42,933	43,442	43,903	44,364	44,822	45,282	45,742	46,205	46,658
Kings	125,467	127,067	128,248	129,252	130,527	131,808	133,103	134,412	135,741	137,084	138,462
Monroe	34,592	35,214	35,778	36,258	36,827	37,386	37,954	38,512	39,072	39,636	40,204
Nassau	89,460	90,869	92,035	93,106	94,432	95,794	97,184	98,596	100,027	101,506	103,024
New York	61,676	62,494	62,989	63,434	63,982	64,535	65,089	65,639	66,192	66,741	67,305
Niagara	8,745	8,901	9,083	9,259	9,435	9,614	9,794	9,979	10,160	10,351	10,537
Onondaga	21,508	21,926	22,213	22,697	23,038	23,383	23,732	24,077	24,423	24,775	25,117
Orange	23,679	24,033	24,197	24,370	24,620	24,870	25,118	25,366	25,620	25,884	26,137
Putnam	4,937	5,025	5,084	5,162	5,236	5,313	5,392	5,471	5,551	5,632	5,717
Queens	127,132	128,917	130,228	131,464	132,791	134,147	135,510	136,928	138,303	139,712	141,163
Rensselaer	4,415	4,575	4,724	4,796	4,929	5,064	5,204	5,347	5,497	5,649	5,802
Richmond	35,646	36,221	36,639	37,042	37,453	37,870	38,290	38,720	39,152	39,588	40,035
Rockland	27,768	28,011	28,162	28,335	28,560	28,779	29,001	29,226	29,451	29,676	29,906
Saratoga	5,796	6,060	6,243	6,360	6,551	6,745	6,945	7,152	7,365	7,583	7,807
Schenectady	6,076	6,229	6,369	6,501	6,654	6,810	6,968	7,127	7,290	7,457	7,625
Suffolk	97,931	99,717	101,233	102,465	103,940	105,473	107,019	108,612	110,170	111,793	113,479
Sullivan	3,169	3,218	3,227	3,249	3,292	3,336	3,382	3,429	3,475	3,524	3,572
Tompkins	2,114	2,133	2,138	2,152	2,173	2,193	2,214	2,234	2,254	2,273	2,292
Ulster	5,816	5,935	6,019	6,089	6,179	6,272	6,365	6,458	6,554	6,650	6,747
Westchester	70,614	71,627	72,218	72,762	73,454	74,156	74,866	75,588	76,303	77,030	77,770

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:		
	1/1	1/2	1/3	1/4	1/6	1/8	1/10
Albany	11,917	12,199	12,405	12,593	13,111 (2,622) [629] {315}	13,638 (2,728) [655] {327}	14,170 (2,834) [680] {340}
Bronx	86,505	87,727	88,526	89,197	90,764 (18,153) [4,357] {2,178}	92,341 (18,468) [4,432] {2,216}	93,969 (18,794) [4,511] {2,255}
Dutchess	12,379	12,601	12,797	13,020	13,456 (2,691) [646] {323}	13,908 (2,782) [668] {334}	14,377 (2,875) [690] {345}
Erie	41,988	42,465	42,933	43,442	44,364 (8,873) [2,129] {1,065}	45,282 (9,056) [2,174] {1,087}	46,205 (9,241) [2,218] {1,109}
Kings	125,467	127,067	128,248	129,252	131,808 (26,362) [6,327] {3,163}	134,412 (26,882) [6,452] {3,226}	137,084 (27,417) [6,580] {3,290}
Monroe	34,592	35,214	35,778	36,258	37,386 (7,477) [1,795] {897}	38,512 (7,702) [1,849] {924}	39,636 (7,927) [1,903] {951}
Nassau	89,460	90,869	92,035	93,106	95,794 (19,159) [4,598] {2,299}	98,596 (19,719) [4,733] {2,366}	101,506 (20,301) [4,872] {2,436}
New York	61,676	62,494	62,989	63,434	64,535 (12,907) [3,098] {1,549}	65,639 (13,128) [3,151] {1,575}	66,741 (13,348) [3,204] {1,602}
Niagara	8,745	8,901	9,083	9,259	9,614 (1,923) [461] {231}	9,979 (1,996) [479] {239}	10,351 (2,070) [497] {248}
Onondaga	21,508	21,926	22,213	22,697	23,383 (4,677) [1,122] {561}	24,077 (4,815) [1,156] {578}	24,775 (4,955) [1,189] {595}
Orange	23,679	24,033	24,197	24,370	24,870 (4,974) [1,194] {597}	25,366 (5,073) [1,218] {609}	25,884 (5,177) [1,242] {621}
Putnam	4,937	5,025	5,084	5,162	5,313 (1,063) [255] {128}	5,471 (1,094) [263] {131}	5,632 (1,126) [270] {135}
Queens	127,132	128,917	130,228	131,464	134,147 (26,829) [6,439] {3,220}	136,928 (27,386) [6,573] {3,286}	139,712 (27,942) [6,706] {3,353}
Rensselaer	4,415	4,575	4,724	4,796	5,064 (1,013) [243] {122}	5,347 (1,069) [257] {128}	5,649 (1,130) [271] {136}
Richmond	35,646	36,221	36,639	37,042	37,870 (7,574) [1,818] {909}	38,720 (7,744) [1,859] {929}	39,588 (7,918) [1,900] {950}
Rockland	27,768	28,011	28,162	28,335	28,779 (5,756) [1,381] {691}	29,226 (5,845) [1,403] {701}	29,676 (5,935) [1,424] {712}
Saratoga	5,796	6,060	6,243	6,360	6,745 (1,349) [324] {162}	7,152 (1,430) [343] {172}	7,583 (1,517) [364] {182}
Schenectady	6,076	6,229	6,369	6,501	6,810 (1,362) [327] {163}	7,127 (1,425) [342] {171}	7,457 (1,491) [358] {179}
Suffolk	97,931	99,717	101,233	102,465	105,473 (21,095) [5,063] {2,531}	108,612 (21,722) [5,213] {2,607}	111,793 (22,359) [5,366] {2,683}
Sullivan	3,169	3,218	3,227	3,249	3,336 (667) [160] {80}	3,429 (686) [165] {82}	3,524 (705) [169] {85}
Tompkins	2,114	2,133	2,138	2,152	2,193 (439) [105] {53}	2,234 (447) [107] {54}	2,273 (455) [109] {55}
Ulster	5,816	5,935	6,019	6,089	6,272 (1,254) [301] {151}	6,458 (1,292) [310] {155}	6,650 (1,330) [319] {160}
Westchester	70,614	71,627	72,218	72,762	74,156 (14,831) [3,559] {1,780}	75,588 (15,118) [3,628] {1,814}	77,030 (15,406) [3,697] {1,849}

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.