IEM's AI Modeling: Short-term COVID-19 Projections
Date: 9/22/21

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 9/22/21 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
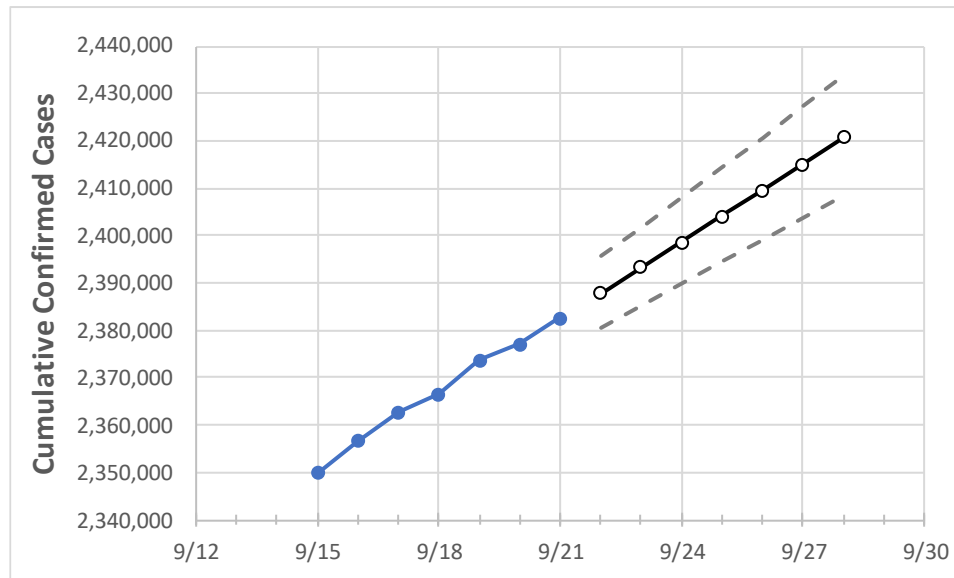
	Actual Confirmed Cases On:				Projected Cases For:						
	9/18	9/19	9/20	9/21	9/22	9/23	9/24	9/25	9/26	9/27	9/28
New York	2,366,441	2,373,659	2,377,102	2,382,450	2,387,922	2,393,211	2,398,577	2,404,044	2,409,527	2,414,944	2,420,758

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:						
	9/18	9/19	9/20	9/21	9/22	9/23	9/24	9/25	9/26	9/27	9/28
Albany	28,164	28,239	28,279	28,365	28,438	28,511	28,585	28,658	28,734	28,809	28,884
Bronx	200,959	201,249	201,398	201,627	201,871	202,115	202,358	202,599	202,838	203,079	203,313
Dutchess	33,516	33,589	33,633	33,716	33,800	33,882	33,968	34,054	34,135	34,222	34,310
Erie	98,209	98,475	98,628	98,871	99,107	99,350	99,589	99,829	100,077	100,341	100,587
Kings	316,218	316,934	317,436	318,011	318,652	319,294	319,927	320,586	321,248	321,917	322,573
Monroe	77,364	77,583	77,703	77,896	78,077	78,265	78,454	78,643	78,832	79,022	79,220
Nassau	205,391	205,748	205,971	206,372	206,763	207,148	207,537	207,919	208,308	208,701	209,088
New York	160,392	160,774	161,006	161,291	161,646	161,995	162,354	162,708	163,071	163,420	163,780
Niagara	21,932	22,005	22,031	22,094	22,155	22,214	22,274	22,337	22,402	22,468	22,533
Onondaga	45,229	45,436	45,521	45,732	45,917	46,101	46,286	46,473	46,659	46,860	47,056
Orange	54,147	54,237	54,325	54,422	54,531	54,641	54,748	54,858	54,967	55,076	55,185
Putnam	11,742	11,765	11,779	11,808	11,832	11,855	11,878	11,902	11,926	11,951	11,975
Queens	303,984	304,468	304,775	305,255	305,697	306,130	306,574	307,027	307,475	307,926	308,386
Rensselaer	13,126	13,180	13,209	13,276	13,323	13,372	13,419	13,469	13,518	13,569	13,619
Richmond	85,139	85,309	85,397	85,558	85,711	85,862	86,013	86,164	86,313	86,465	86,615
Rockland	50,497	50,600	50,716	50,818	50,911	51,006	51,103	51,201	51,302	51,406	51,513
Saratoga	18,254	18,312	18,342	18,388	18,441	18,493	18,547	18,599	18,653	18,707	18,757
Schenectady	15,123	15,162	15,199	15,251	15,291	15,334	15,375	15,418	15,460	15,504	15,547
Suffolk	225,877	226,321	226,574	227,181	227,701	228,212	228,715	229,235	229,747	230,269	230,784
Sullivan	7,740	7,765	7,773	7,787	7,809	7,831	7,853	7,875	7,898	7,919	7,942
Tompkins	5,841	5,889	5,901	5,926	5,956	5,987	6,016	6,047	6,076	6,106	6,135
Ulster	16,195	16,239	16,274	16,310	16,358	16,406	16,455	16,504	16,552	16,601	16,649
Westchester	140,204	140,362	140,481	140,626	140,787	140,943	141,104	141,262	141,419	141,574	141,731

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:		
	9/18	9/19	9/20	9/21	9/23	9/25	9/27
Albany	28,164	28,239	28,279	28,365	28,511 (5,702) [1,369] {684}	28,658 (5,732) [1,376] {688}	28,809 (5,762) [1,383] {691}
Bronx	200,959	201,249	201,398	201,627	202,115 (40,423) [9,702] {4,851}	202,599 (40,520) [9,725] {4,862}	203,079 (40,616) [9,748] {4,874}
Dutchess	33,516	33,589	33,633	33,716	33,882 (6,776) [1,626] {813}	34,054 (6,811) [1,635] {817}	34,222 (6,844) [1,643] {821}
Erie	98,209	98,475	98,628	98,871	99,350 (19,870) [4,769] {2,384}	99,829 (19,966) [4,792] {2,396}	100,341 (20,068) [4,816] {2,408}
Kings	316,218	316,934	317,436	318,011	319,294 (63,859) [15,326] {7,663}	320,586 (64,117) [15,388] {7,694}	321,917 (64,383) [15,452] {7,726}
Monroe	77,364	77,583	77,703	77,896	78,265 (15,653) [3,757] {1,878}	78,643 (15,729) [3,775] {1,887}	79,022 (15,804) [3,793] {1,897}
Nassau	205,391	205,748	205,971	206,372	207,148 (41,430) [9,943] {4,972}	207,919 (41,584) [9,980] {4,990}	208,701 (41,740) [10,018] {5,009}
New York	160,392	160,774	161,006	161,291	161,995 (32,399) [7,776] {3,888}	162,708 (32,542) [7,810] {3,905}	163,420 (32,684) [7,844] {3,922}
Niagara	21,932	22,005	22,031	22,094	22,214 (4,443) [1,066] {533}	22,337 (4,467) [1,072] {536}	22,468 (4,494) [1,078] {539}
Onondaga	45,229	45,436	45,521	45,732	46,101 (9,220) [2,213] {1,106}	46,473 (9,295) [2,231] {1,115}	46,860 (9,372) [2,249] {1,125}
Orange	54,147	54,237	54,325	54,422	54,641 (10,928) [2,623] {1,311}	54,858 (10,972) [2,633] {1,317}	55,076 (11,015) [2,644] {1,322}
Putnam	11,742	11,765	11,779	11,808	11,855 (2,371) [569] {285}	11,902 (2,380) [571] {286}	11,951 (2,390) [574] {287}
Queens	303,984	304,468	304,775	305,255	306,130 (61,226) [14,694] {7,347}	307,027 (61,405) [14,737] {7,369}	307,926 (61,585) [14,780] {7,390}
Rensselaer	13,126	13,180	13,209	13,276	13,372 (2,674) [642] {321}	13,469 (2,694) [647] {323}	13,569 (2,714) [651] {326}
Richmond	85,139	85,309	85,397	85,558	85,862 (17,172) [4,121] {2,061}	86,164 (17,233) [4,136] {2,068}	86,465 (17,293) [4,150] {2,075}
Rockland	50,497	50,600	50,716	50,818	51,006 (10,201) [2,448] {1,224}	51,201 (10,240) [2,458] {1,229}	51,406 (10,281) [2,467] {1,234}
Saratoga	18,254	18,312	18,342	18,388	18,493 (3,699) [888] {444}	18,599 (3,720) [893] {446}	18,707 (3,741) [898] {449}
Schenectady	15,123	15,162	15,199	15,251	15,334 (3,067) [736] {368}	15,418 (3,084) [740] {370}	15,504 (3,101) [744] {372}
Suffolk	225,877	226,321	226,574	227,181	228,212 (45,642) [10,954] {5,477}	229,235 (45,847) [11,003] {5,502}	230,269 (46,054) [11,053] {5,526}
Sullivan	7,740	7,765	7,773	7,787	7,831 (1,566) [376] {188}	7,875 (1,575) [378] {189}	7,919 (1,584) [380] {190}
Tompkins	5,841	5,889	5,901	5,926	5,987 (1,197) [287] {144}	6,047 (1,209) [290] {145}	6,106 (1,221) [293] {147}
Ulster	16,195	16,239	16,274	16,310	16,406 (3,281) [787] {394}	16,504 (3,301) [792] {396}	16,601 (3,320) [797] {398}
Westchester	140,204	140,362	140,481	140,626	140,943 (28,189) [6,765] {3,383}	141,262 (28,252) [6,781] {3,390}	141,574 (28,315) [6,796] {3,398}

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.