IEM's AI Modeling: Short-term COVID-19 Projections
Date: 3/24/21

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 3/24/21 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
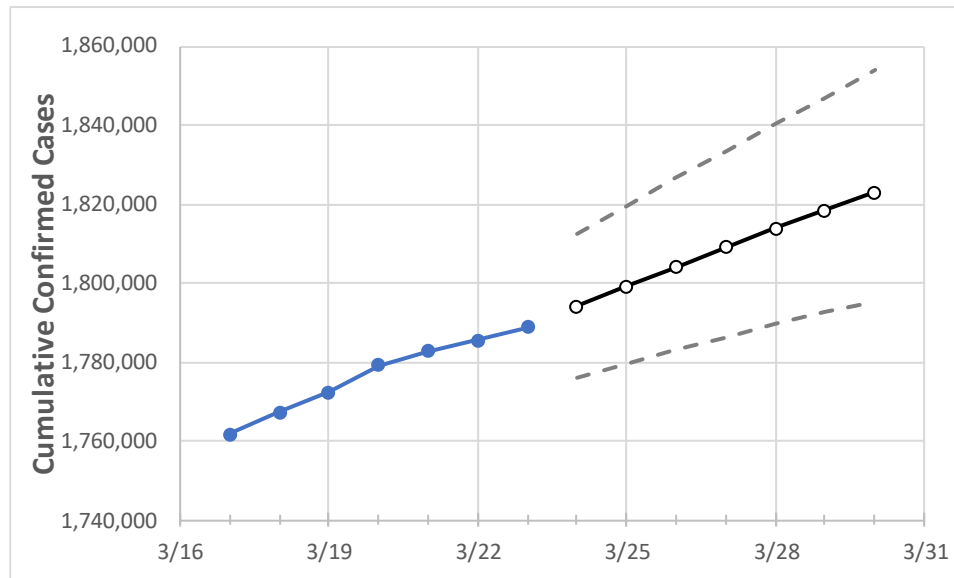
	Actual Confirmed Cases On:				Projected Cases For:						
	3/20	3/21	3/22	3/23	3/24	3/25	3/26	3/27	3/28	3/29	3/30
New York	1,779,034	1,782,769	1,785,565	1,788,874	1,794,019	1,799,067	1,804,023	1,808,932	1,813,726	1,818,411	1,823,018

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:						
	3/20	3/21	3/22	3/23	3/24	3/25	3/26	3/27	3/28	3/29	3/30
Albany	21,914	21,982	22,024	22,078	22,128	22,178	22,227	22,275	22,324	22,372	22,421
Bronx	156,250	156,250	156,250	156,250	156,640	157,017	157,387	157,739	158,093	158,429	158,755
Dutchess	24,571	24,744	24,862	24,977	25,116	25,256	25,400	25,545	25,692	25,841	25,990
Erie	69,936	70,323	70,520	70,826	71,085	71,350	71,613	71,885	72,159	72,433	72,706
Kings	231,077	231,077	231,077	231,077	231,883	232,669	233,434	234,173	234,922	235,632	236,342
Monroe	54,934	55,119	55,213	55,335	55,454	55,576	55,700	55,819	55,942	56,063	56,184
Nassau	160,800	161,408	161,948	162,481	163,094	163,699	164,310	164,907	165,505	166,110	166,697
New York	113,760	113,760	113,760	113,760	114,130	114,488	114,848	115,188	115,524	115,857	116,189
Niagara	15,965	16,009	16,050	16,086	16,119	16,152	16,186	16,219	16,252	16,285	16,317
Onondaga	33,504	33,584	33,617	33,689	33,748	33,807	33,867	33,928	33,988	34,051	34,112
Orange	40,780	40,993	41,137	41,370	41,590	41,810	42,033	42,261	42,487	42,716	42,949
Putnam	9,033	9,079	9,106	9,146	9,186	9,226	9,266	9,307	9,349	9,390	9,432
Queens	230,868	230,868	230,868	230,868	231,673	232,460	233,247	234,010	234,765	235,506	236,241
Rensselaer	9,625	9,657	9,679	9,705	9,733	9,761	9,788	9,816	9,843	9,871	9,898
Richmond	61,922	61,922	61,922	61,922	62,112	62,296	62,483	62,664	62,842	63,011	63,177
Rockland	41,858	41,990	42,077	42,250	42,402	42,554	42,706	42,857	43,007	43,155	43,306
Saratoga	12,774	12,834	12,870	12,924	12,969	13,014	13,061	13,107	13,154	13,201	13,248
Schenectady	11,381	11,407	11,430	11,470	11,498	11,526	11,553	11,581	11,609	11,637	11,665
Suffolk	174,799	175,528	176,140	176,669	177,335	177,991	178,660	179,335	180,012	180,688	181,373
Sullivan	5,186	5,216	5,231	5,268	5,298	5,329	5,360	5,392	5,425	5,459	5,493
Tompkins	3,718	3,730	3,736	3,742	3,758	3,773	3,789	3,805	3,821	3,838	3,855
Ulster	11,123	11,203	11,274	11,354	11,436	11,521	11,607	11,696	11,790	11,886	11,986
Westchester	115,222	115,563	115,935	116,289	116,661	117,027	117,394	117,760	118,124	118,489	118,852

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:		
	3/20	3/21	3/22	3/23	3/25	3/27	3/29
Albany	21,914	21,982	22,024	22,078	22,178 (4,436) [1,065] {532}	22,275 (4,455) [1,069] {535}	22,372 (4,474) [1,074] {537}
Bronx	156,250	156,250	156,250	156,250	157,017 (31,403) [7,537] {3,768}	157,739 (31,548) [7,571] {3,786}	158,429 (31,686) [7,605] {3,802}
Dutchess	24,571	24,744	24,862	24,977	25,256 (5,051) [1,212] {606}	25,545 (5,109) [1,226] {613}	25,841 (5,168) [1,240] {620}
Erie	69,936	70,323	70,520	70,826	71,350 (14,270) [3,425] {1,712}	71,885 (14,377) [3,450] {1,725}	72,433 (14,487) [3,477] {1,738}
Kings	231,077	231,077	231,077	231,077	232,669 (46,534) [11,168] {5,584}	234,173 (46,835) [11,240] {5,620}	235,632 (47,126) [11,310] {5,655}
Monroe	54,934	55,119	55,213	55,335	55,576 (11,115) [2,668] {1,334}	55,819 (11,164) [2,679] {1,340}	56,063 (11,213) [2,691] {1,346}
Nassau	160,800	161,408	161,948	162,481	163,699 (32,740) [7,858] {3,929}	164,907 (32,981) [7,916] {3,958}	166,110 (33,222) [7,973] {3,987}
New York	113,760	113,760	113,760	113,760	114,488 (22,898) [5,495] {2,748}	115,188 (23,038) [5,529] {2,765}	115,857 (23,171) [5,561] {2,781}
Niagara	15,965	16,009	16,050	16,086	16,152 (3,230) [775] {388}	16,219 (3,244) [779] {389}	16,285 (3,257) [782] {391}
Onondaga	33,504	33,584	33,617	33,689	33,807 (6,761) [1,623] {811}	33,928 (6,786) [1,629] {814}	34,051 (6,810) [1,634] {817}
Orange	40,780	40,993	41,137	41,370	41,810 (8,362) [2,007] {1,003}	42,261 (8,452) [2,029] {1,014}	42,716 (8,543) [2,050] {1,025}
Putnam	9,033	9,079	9,106	9,146	9,226 (1,845) [443] {221}	9,307 (1,861) [447] {223}	9,390 (1,878) [451] {225}
Queens	230,868	230,868	230,868	230,868	232,460 (46,492) [11,158] {5,579}	234,010 (46,802) [11,232] {5,616}	235,506 (47,101) [11,304] {5,652}
Rensselaer	9,625	9,657	9,679	9,705	9,761 (1,952) [469] {234}	9,816 (1,963) [471] {236}	9,871 (1,974) [474] {237}
Richmond	61,922	61,922	61,922	61,922	62,296 (12,459) [2,990] {1,495}	62,664 (12,533) [3,008] {1,504}	63,011 (12,602) [3,025] {1,512}
Rockland	41,858	41,990	42,077	42,250	42,554 (8,511) [2,043] {1,021}	42,857 (8,571) [2,057] {1,029}	43,155 (8,631) [2,071] {1,036}
Saratoga	12,774	12,834	12,870	12,924	13,014 (2,603) [625] {312}	13,107 (2,621) [629] {315}	13,201 (2,640) [634] {317}
Schenectady	11,381	11,407	11,430	11,470	11,526 (2,305) [553] {277}	11,581 (2,316) [556] {278}	11,637 (2,327) [559] {279}
Suffolk	174,799	175,528	176,140	176,669	177,991 (35,598) [8,544] {4,272}	179,335 (35,867) [8,608] {4,304}	180,688 (36,138) [8,673] {4,337}
Sullivan	5,186	5,216	5,231	5,268	5,329 (1,066) [256] {128}	5,392 (1,078) [259] {129}	5,459 (1,092) [262] {131}
Tompkins	3,718	3,730	3,736	3,742	3,773 (755) [181] {91}	3,805 (761) [183] {91}	3,838 (768) [184] {92}
Ulster	11,123	11,203	11,274	11,354	11,521 (2,304) [553] {276}	11,696 (2,339) [561] {281}	11,886 (2,377) [571] {285}
Westchester	115,222	115,563	115,935	116,289	117,027 (23,405) [5,617] {2,809}	117,760 (23,552) [5,652] {2,826}	118,489 (23,698) [5,687] {2,844}

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.