IEM's AI Modeling: Short-term COVID-19 Projections
Date: 5/18/21

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 5/18/21 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
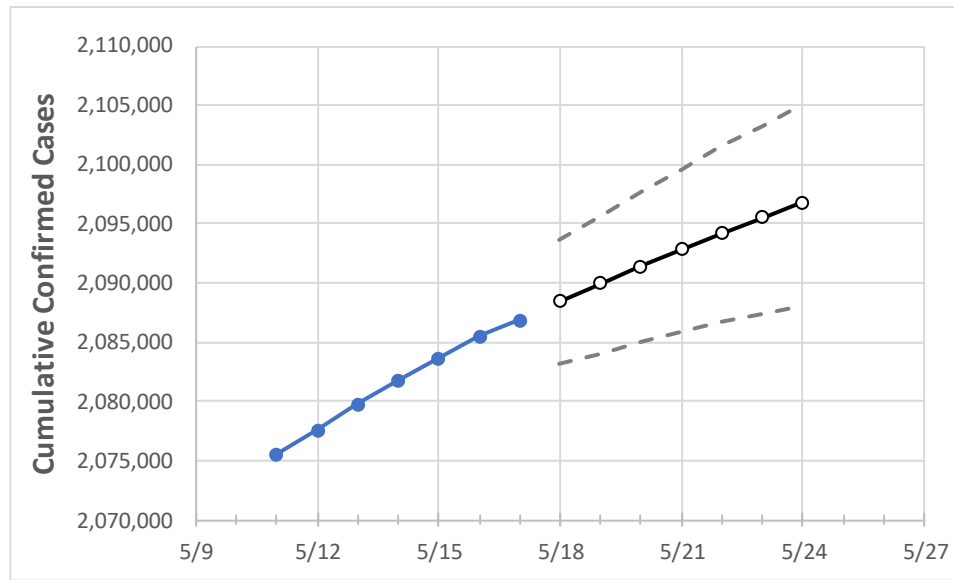
	Actual Confirmed Cases On:				Projected Cases For:						
	5/14	5/15	5/16	5/17	5/18	5/19	5/20	5/21	5/22	5/23	5/24
New York	2,081,823	2,083,623	2,085,477	2,086,836	2,088,435	2,089,963	2,091,413	2,092,822	2,094,184	2,095,524	2,096,780

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:						
	5/14	5/15	5/16	5/17	5/18	5/19	5/20	5/21	5/22	5/23	5/24
Albany	24,406	24,428	24,445	24,455	24,472	24,488	24,504	24,519	24,534	24,549	24,565
Bronx	181,160	181,231	181,406	181,500	181,609	181,713	181,810	181,907	182,002	182,089	182,173
Dutchess	29,137	29,175	29,194	29,214	29,236	29,258	29,279	29,299	29,318	29,335	29,353
Erie	88,228	88,350	88,434	88,507	88,598	88,686	88,770	88,851	88,929	89,001	89,072
Kings	277,059	277,183	277,468	277,651	277,842	278,025	278,201	278,369	278,530	278,680	278,819
Monroe	66,507	66,700	66,865	66,986	67,153	67,316	67,478	67,638	67,798	67,954	68,105
Nassau	182,139	182,253	182,343	182,422	182,506	182,586	182,663	182,737	182,809	182,878	182,944
New York	136,724	136,828	136,921	136,977	137,058	137,135	137,210	137,282	137,355	137,421	137,488
Niagara	19,656	19,686	19,704	19,721	19,748	19,774	19,799	19,822	19,845	19,867	19,889
Onondaga	37,973	38,048	38,098	38,132	38,183	38,234	38,285	38,333	38,383	38,432	38,481
Orange	47,808	47,851	47,883	47,908	47,937	47,965	47,992	48,018	48,043	48,067	48,090
Putnam	10,534	10,539	10,541	10,542	10,546	10,549	10,552	10,555	10,558	10,561	10,564
Queens	273,939	274,033	274,314	274,493	274,663	274,827	274,982	275,132	275,280	275,420	275,555
Rensselaer	11,089	11,104	11,114	11,123	11,135	11,147	11,159	11,171	11,183	11,194	11,206
Richmond	73,935	73,971	74,065	74,109	74,161	74,209	74,256	74,300	74,343	74,385	74,425
Rockland	46,626	46,656	46,673	46,697	46,713	46,728	46,741	46,754	46,768	46,780	46,792
Saratoga	15,090	15,113	15,123	15,136	15,155	15,173	15,191	15,209	15,227	15,244	15,260
Schenectady	12,972	12,988	12,999	13,009	13,024	13,038	13,051	13,065	13,078	13,091	13,104
Suffolk	199,282	199,411	199,506	199,592	199,687	199,778	199,865	199,947	200,029	200,106	200,179
Sullivan	6,537	6,549	6,552	6,558	6,565	6,572	6,578	6,584	6,590	6,596	6,601
Tompkins	4,230	4,241	4,250	4,256	4,263	4,269	4,275	4,282	4,288	4,295	4,301
Ulster	13,747	13,762	13,777	13,788	13,799	13,810	13,821	13,830	13,840	13,849	13,857
Westchester	128,763	128,835	128,864	128,897	128,941	128,983	129,023	129,061	129,096	129,130	129,163

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:		
	5/14	5/15	5/16	5/17	5/19	5/21	5/23
Albany	24,406	24,428	24,445	24,455	24,488 (4,898) [1,175] {588}	24,519 (4,904) [1,177] {588}	24,549 (4,910) [1,178] {589}
Bronx	181,160	181,231	181,406	181,500	181,713 (36,343) [8,722] {4,361}	181,907 (36,381) [8,732] {4,366}	182,089 (36,418) [8,740] {4,370}
Dutchess	29,137	29,175	29,194	29,214	29,258 (5,852) [1,404] {702}	29,299 (5,860) [1,406] {703}	29,335 (5,867) [1,408] {704}
Erie	88,228	88,350	88,434	88,507	88,686 (17,737) [4,257] {2,128}	88,851 (17,770) [4,265] {2,132}	89,001 (17,800) [4,272] {2,136}
Kings	277,059	277,183	277,468	277,651	278,025 (55,605) [13,345] {6,673}	278,369 (55,674) [13,362] {6,681}	278,680 (55,736) [13,377] {6,688}
Monroe	66,507	66,700	66,865	66,986	67,316 (13,463) [3,231] {1,616}	67,638 (13,528) [3,247] {1,623}	67,954 (13,591) [3,262] {1,631}
Nassau	182,139	182,253	182,343	182,422	182,586 (36,517) [8,764] {4,382}	182,737 (36,547) [8,771] {4,386}	182,878 (36,576) [8,778] {4,389}
New York	136,724	136,828	136,921	136,977	137,135 (27,427) [6,582] {3,291}	137,282 (27,456) [6,590] {3,295}	137,421 (27,484) [6,596] {3,298}
Niagara	19,656	19,686	19,704	19,721	19,774 (3,955) [949] {475}	19,822 (3,964) [951] {476}	19,867 (3,973) [954] {477}
Onondaga	37,973	38,048	38,098	38,132	38,234 (7,647) [1,835] {918}	38,333 (7,667) [1,840] {920}	38,432 (7,686) [1,845] {922}
Orange	47,808	47,851	47,883	47,908	47,965 (9,593) [2,302] {1,151}	48,018 (9,604) [2,305] {1,152}	48,067 (9,613) [2,307] {1,154}
Putnam	10,534	10,539	10,541	10,542	10,549 (2,110) [506] {253}	10,555 (2,111) [507] {253}	10,561 (2,112) [507] {253}
Queens	273,939	274,033	274,314	274,493	274,827 (54,965) [13,192] {6,596}	275,132 (55,026) [13,206] {6,603}	275,420 (55,084) [13,220] {6,610}
Rensselaer	11,089	11,104	11,114	11,123	11,147 (2,229) [535] {268}	11,171 (2,234) [536] {268}	11,194 (2,239) [537] {269}
Richmond	73,935	73,971	74,065	74,109	74,209 (14,842) [3,562] {1,781}	74,300 (14,860) [3,566] {1,783}	74,385 (14,877) [3,570] {1,785}
Rockland	46,626	46,656	46,673	46,697	46,728 (9,346) [2,243] {1,121}	46,754 (9,351) [2,244] {1,122}	46,780 (9,356) [2,245] {1,123}
Saratoga	15,090	15,113	15,123	15,136	15,173 (3,035) [728] {364}	15,209 (3,042) [730] {365}	15,244 (3,049) [732] {366}
Schenectady	12,972	12,988	12,999	13,009	13,038 (2,608) [626] {313}	13,065 (2,613) [627] {314}	13,091 (2,618) [628] {314}
Suffolk	199,282	199,411	199,506	199,592	199,778 (39,956) [9,589] {4,795}	199,947 (39,989) [9,597] {4,799}	200,106 (40,021) [9,605] {4,803}
Sullivan	6,537	6,549	6,552	6,558	6,572 (1,314) [315] {158}	6,584 (1,317) [316] {158}	6,596 (1,319) [317] {158}
Tompkins	4,230	4,241	4,250	4,256	4,269 (854) [205] {102}	4,282 (856) [206] {103}	4,295 (859) [206] {103}
Ulster	13,747	13,762	13,777	13,788	13,810 (2,762) [663] {331}	13,830 (2,766) [664] {332}	13,849 (2,770) [665] {332}
Westchester	128,763	128,835	128,864	128,897	128,983 (25,797) [6,191] {3,096}	129,061 (25,812) [6,195] {3,097}	129,130 (25,826) [6,198] {3,099}

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.