IEM's AI Modeling: Short-term COVID-19 Projections

Date: 4/23/21

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 not 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 4/23/21 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.

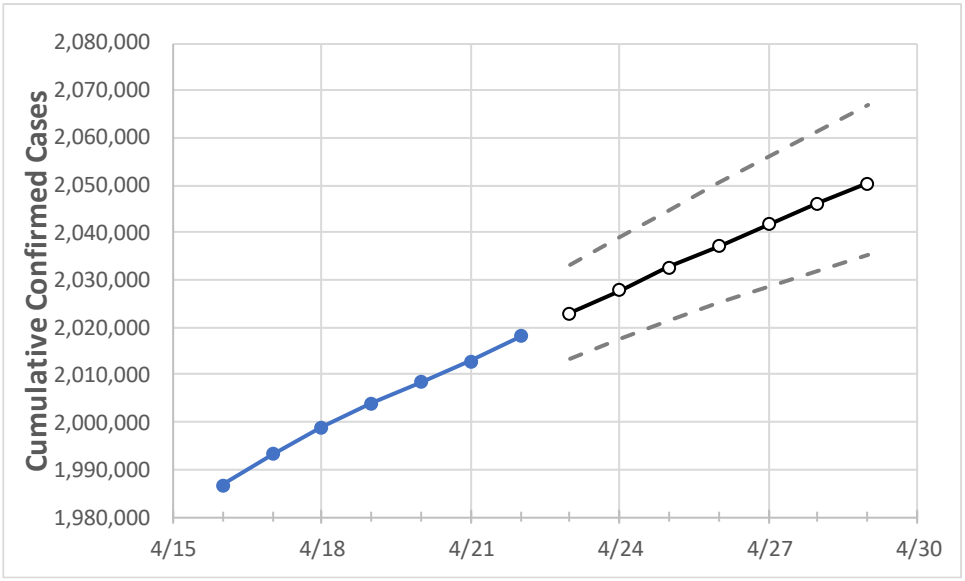
IEM's Modeling Lead

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:						
	4/19	4/20	4/21	4/22	4/23	4/24	4/25	4/26	4/27	4/28	4/29
New York	2,003,938	2,008,514	2,012,806	2,018,044	2,022,963	2,027,754	2,032,608	2,037,201	2,041,771	2,046,167	2,050,451

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:						
	4/19	4/20	4/21	4/22	4/23	4/24	4/25	4/26	4/27	4/28	4/29
Albany	23,718	23,772	23,800	23,870	23,922	23,975	24,027	24,078	24,129	24,179	24,229
Bronx	175,323	175,767	176,071	176,494	176,863	177,224	177,573	177,913	178,242	178,568	178,877
Dutchess	28,027	28,092	28,147	28,213	28,278	28,342	28,402	28,461	28,518	28,573	28,627
Erie	82,901	83,198	83,524	83,918	84,350	84,780	85,202	85,633	86,064	86,498	86,920
Kings	265,709	266,498	267,114	267,936	268,726	269,507	270,275	271,019	271,744	272,471	273,152
Monroe	61,314	61,493	61,716	62,001	62,277	62,553	62,835	63,115	63,404	63,690	63,976
Nassau	177,656	177,933	178,235	178,512	178,843	179,171	179,487	179,787	180,081	180,367	180,650
New York	132,551	132,760	133,042	133,306	133,603	133,888	134,171	134,440	134,705	134,963	135,221
Niagara	18,367	18,436	18,486	18,536	18,625	18,714	18,803	18,892	18,981	19,069	19,154
Onondaga	36,119	36,191	36,254	36,344	36,437	36,531	36,625	36,719	36,813	36,904	36,997
Orange	46,223	46,304	46,388	46,540	46,643	46,741	46,837	46,930	47,021	47,103	47,188
Putnam	10,231	10,245	10,274	10,301	10,324	10,346	10,368	10,389	10,410	10,430	10,449
Queens	264,360	265,118	265,673	266,379	267,042	267,679	268,289	268,882	269,459	270,027	270,579
Rensselaer	10,709	10,726	10,745	10,776	10,804	10,832	10,860	10,886	10,913	10,939	10,963
Richmond	70,965	71,196	71,390	71,608	71,812	72,014	72,214	72,409	72,599	72,783	72,968
Rockland	45,739	45,795	45,849	45,922	45,987	46,051	46,112	46,170	46,226	46,282	46,331
Saratoga	14,454	14,477	14,517	14,550	14,590	14,629	14,667	14,703	14,738	14,773	14,806
Schenectady	12,435	12,457	12,471	12,505	12,532	12,558	12,583	12,609	12,633	12,658	12,683
Suffolk	193,919	194,209	194,512	194,868	195,262	195,649	196,020	196,392	196,745	197,078	197,411
Sullivan	6,167	6,192	6,210	6,235	6,260	6,285	6,310	6,335	6,358	6,381	6,404
Tompkins	4,064	4,066	4,077	4,087	4,093	4,098	4,104	4,109	4,114	4,118	4,123
Ulster	13,082	13,116	13,159	13,205	13,245	13,284	13,321	13,358	13,394	13,430	13,464
Westchester	125,913	126,094	126,278	126,494	126,701	126,896	127,094	127,282	127,467	127,645	127,815

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:		
	4/19	4/20	4/21	4/22	4/24	4/26	4/28
Albany	23,718	23,772	23,800	23,870	23,975 (4,795) [1,151] {575}	24,078 (4,816) [1,156] {578}	24,179 (4,836) [1,161] {580}
Bronx	175,323	175,767	176,071	176,494	177,224 (35,445) [8,507] {4,253}	177,913 (35,583) [8,540] {4,270}	178,568 (35,714) [8,571] {4,286}
Dutchess	28,027	28,092	28,147	28,213	28,342 (5,668) [1,360] {680}	28,461 (5,692) [1,366] {683}	28,573 (5,715) [1,372] {686}
Erie	82,901	83,198	83,524	83,918	84,780 (16,956) [4,069] {2,035}	85,633 (17,127) [4,110] {2,055}	86,498 (17,300) [4,152] {2,076}
Kings	265,709	266,498	267,114	267,936	269,507 (53,901) [12,936] {6,468}	271,019 (54,204) [13,009] {6,504}	272,471 (54,494) [13,079] {6,539}
Monroe	61,314	61,493	61,716	62,001	62,553 (12,511) [3,003] {1,501}	63,115 (12,623) [3,030] {1,515}	63,690 (12,738) [3,057] {1,529}
Nassau	177,656	177,933	178,235	178,512	179,171 (35,834) [8,600] {4,300}	179,787 (35,957) [8,630] {4,315}	180,367 (36,073) [8,658] {4,329}
New York	132,551	132,760	133,042	133,306	133,888 (26,778) [6,427] {3,213}	134,440 (26,888) [6,453] {3,227}	134,963 (26,993) [6,478] {3,239}
Niagara	18,367	18,436	18,486	18,536	18,714 (3,743) [898] {449}	18,892 (3,778) [907] {453}	19,069 (3,814) [915] {458}
Onondaga	36,119	36,191	36,254	36,344	36,531 (7,306) [1,753] {877}	36,719 (7,344) [1,762] {881}	36,904 (7,381) [1,771] {886}
Orange	46,223	46,304	46,388	46,540	46,741 (9,348) [2,244] {1,122}	46,930 (9,386) [2,253] {1,126}	47,103 (9,421) [2,261] {1,130}
Putnam	10,231	10,245	10,274	10,301	10,346 (2,069) [497] {248}	10,389 (2,078) [499] {249}	10,430 (2,086) [501] {250}
Queens	264,360	265,118	265,673	266,379	267,679 (53,536) [12,849] {6,424}	268,882 (53,776) [12,906] {6,453}	270,027 (54,005) [12,961] {6,481}
Rensselaer	10,709	10,726	10,745	10,776	10,832 (2,166) [520] {260}	10,886 (2,177) [523] {261}	10,939 (2,188) [525] {263}
Richmond	70,965	71,196	71,390	71,608	72,014 (14,403) [3,457] {1,728}	72,409 (14,482) [3,476] {1,738}	72,783 (14,557) [3,494] {1,747}
Rockland	45,739	45,795	45,849	45,922	46,051 (9,210) [2,210] {1,105}	46,170 (9,234) [2,216] {1,108}	46,282 (9,256) [2,222] {1,111}
Saratoga	14,454	14,477	14,517	14,550	14,629 (2,926) [702] {351}	14,703 (2,941) [706] {353}	14,773 (2,955) [709] {355}
Schenectady	12,435	12,457	12,471	12,505	12,558 (2,512) [603] {301}	12,609 (2,522) [605] {303}	12,658 (2,532) [608] {304}
Suffolk	193,919	194,209	194,512	194,868	195,649 (39,130) [9,391] {4,696}	196,392 (39,278) [9,427] {4,713}	197,078 (39,416) [9,460] {4,730}
Sullivan	6,167	6,192	6,210	6,235	6,285 (1,257) [302] {151}	6,335 (1,267) [304] {152}	6,381 (1,276) [306] {153}
Tompkins	4,064	4,066	4,077	4,087	4,098 (820) [197] {98}	4,109 (822) [197] {99}	4,118 (824) [198] {99}
Ulster	13,082	13,116	13,159	13,205	13,284 (2,657) [638] {319}	13,358 (2,672) [641] {321}	13,430 (2,686) [645] {322}
Westchester	125,913	126,094	126,278	126,494	126,896 (25,379) [6,091] {3,046}	127,282 (25,456) [6,110] {3,055}	127,645 (25,529) [6,127] {3,063}

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.