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

Date: 4/7/21

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 4/7/21 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.

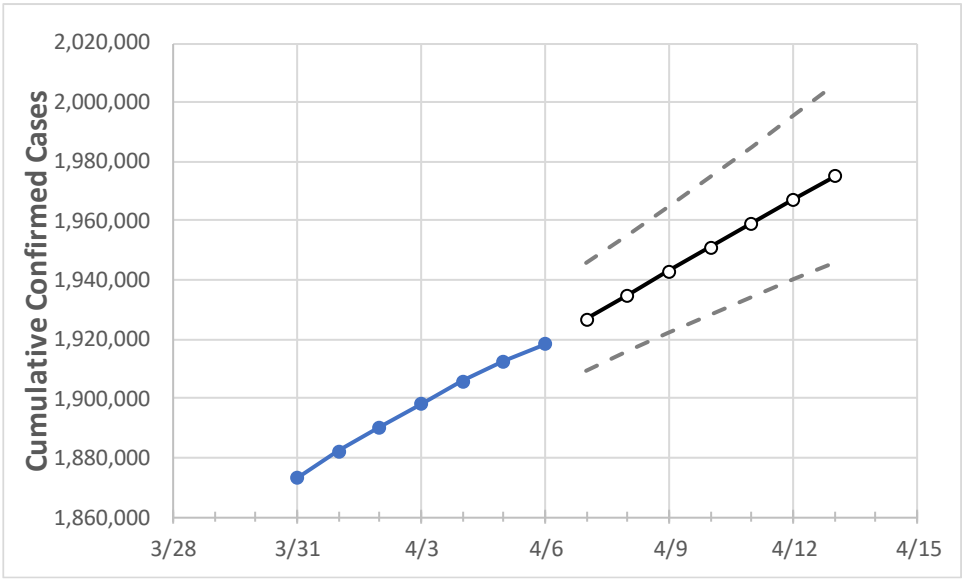
IEM's Modeling Lead

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:						
	4/3	4/4	4/5	4/6	4/7	4/8	4/9	4/10	4/11	4/12	4/13
New York	1,898,101	1,905,737	1,912,396	1,918,437	1,926,632	1,934,847	1,943,005	1,951,040	1,959,170	1,967,115	1,974,966

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:						
	4/3	4/4	4/5	4/6	4/7	4/8	4/9	4/10	4/11	4/12	4/13
Albany	22,799	22,855	22,925	22,965	23,028	23,092	23,156	23,219	23,284	23,347	23,411
Bronx	167,221	167,901	168,418	168,921	169,602	170,295	170,973	171,664	172,375	173,062	173,752
Dutchess	26,450	26,573	26,680	26,776	26,905	27,032	27,156	27,281	27,409	27,536	27,663
Erie	75,400	75,876	76,365	76,665	77,151	77,649	78,156	78,676	79,198	79,736	80,281
Kings	249,957	251,097	252,049	253,120	254,163	255,198	256,201	257,189	258,159	259,113	260,054
Monroe	57,350	57,538	57,780	57,911	58,121	58,337	58,555	58,778	59,004	59,238	59,473
Nassau	169,535	170,179	170,680	171,185	171,774	172,364	172,939	173,515	174,079	174,640	175,203
New York	125,259	125,851	126,316	126,686	127,262	127,823	128,380	128,947	129,481	130,030	130,556
Niagara	16,800	16,900	17,014	17,076	17,168	17,264	17,361	17,462	17,569	17,683	17,801
Onondaga	34,531	34,629	34,741	34,773	34,860	34,949	35,038	35,131	35,224	35,320	35,415
Orange	43,893	44,048	44,185	44,370	44,574	44,775	44,975	45,168	45,365	45,558	45,751
Putnam	9,679	9,729	9,757	9,786	9,833	9,882	9,931	9,980	10,029	10,079	10,127
Queens	249,836	250,990	251,972	252,963	254,085	255,212	256,336	257,459	258,564	259,677	260,750
Rensselaer	10,137	10,181	10,217	10,248	10,289	10,331	10,372	10,414	10,457	10,501	10,544
Richmond	66,793	67,083	67,363	67,627	67,947	68,268	68,597	68,913	69,239	69,555	69,869
Rockland	44,052	44,150	44,234	44,384	44,527	44,668	44,807	44,947	45,086	45,222	45,355
Saratoga	13,599	13,668	13,713	13,752	13,816	13,879	13,944	14,008	14,073	14,140	14,207
Schenectady	11,917	11,951	11,987	11,998	12,032	12,067	12,101	12,135	12,168	12,201	12,234
Suffolk	184,645	185,345	185,911	186,487	187,160	187,820	188,481	189,135	189,784	190,422	191,054
Sullivan	5,664	5,691	5,710	5,733	5,770	5,807	5,844	5,882	5,920	5,959	5,999
Tompkins	3,932	3,944	3,951	3,956	3,969	3,982	3,995	4,007	4,020	4,032	4,044
Ulster	12,205	12,271	12,322	12,378	12,454	12,529	12,604	12,677	12,752	12,827	12,900
Westchester	121,124	121,507	121,803	122,066	122,450	122,836	123,223	123,600	123,971	124,344	124,711

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:		
	4/3	4/4	4/5	4/6	4/8	4/10	4/12
Albany	22,799	22,855	22,925	22,965	23,092 (4,618) [1,108] {554}	23,219 (4,644) [1,115] {557}	23,347 (4,669) [1,121] {560}
Bronx	167,221	167,901	168,418	168,921	170,295 (34,059) [8,174] {4,087}	171,664 (34,333) [8,240] {4,120}	173,062 (34,612) [8,307] {4,153}
Dutchess	26,450	26,573	26,680	26,776	27,032 (5,406) [1,298] {649}	27,281 (5,456) [1,309] {655}	27,536 (5,507) [1,322] {661}
Erie	75,400	75,876	76,365	76,665	77,649 (15,530) [3,727] {1,864}	78,676 (15,735) [3,776] {1,888}	79,736 (15,947) [3,827] {1,914}
Kings	249,957	251,097	252,049	253,120	255,198 (51,040) [12,249] {6,125}	257,189 (51,438) [12,345] {6,173}	259,113 (51,823) [12,437] {6,219}
Monroe	57,350	57,538	57,780	57,911	58,337 (11,667) [2,800] {1,400}	58,778 (11,756) [2,821] {1,411}	59,238 (11,848) [2,843] {1,422}
Nassau	169,535	170,179	170,680	171,185	172,364 (34,473) [8,273] {4,137}	173,515 (34,703) [8,329] {4,164}	174,640 (34,928) [8,383] {4,191}
New York	125,259	125,851	126,316	126,686	127,823 (25,565) [6,136] {3,068}	128,947 (25,789) [6,189] {3,095}	130,030 (26,006) [6,241] {3,121}
Niagara	16,800	16,900	17,014	17,076	17,264 (3,453) [829] {414}	17,462 (3,492) [838] {419}	17,683 (3,537) [849] {424}
Onondaga	34,531	34,629	34,741	34,773	34,949 (6,990) [1,678] {839}	35,131 (7,026) [1,686] {843}	35,320 (7,064) [1,695] {848}
Orange	43,893	44,048	44,185	44,370	44,775 (8,955) [2,149] {1,075}	45,168 (9,034) [2,168] {1,084}	45,558 (9,112) [2,187] {1,093}
Putnam	9,679	9,729	9,757	9,786	9,882 (1,976) [474] {237}	9,980 (1,996) [479] {240}	10,079 (2,016) [484] {242}
Queens	249,836	250,990	251,972	252,963	255,212 (51,042) [12,250] {6,125}	257,459 (51,492) [12,358] {6,179}	259,677 (51,935) [12,464] {6,232}
Rensselaer	10,137	10,181	10,217	10,248	10,331 (2,066) [496] {248}	10,414 (2,083) [500] {250}	10,501 (2,100) [504] {252}
Richmond	66,793	67,083	67,363	67,627	68,268 (13,654) [3,277] {1,638}	68,913 (13,783) [3,308] {1,654}	69,555 (13,911) [3,339] {1,669}
Rockland	44,052	44,150	44,234	44,384	44,668 (8,934) [2,144] {1,072}	44,947 (8,989) [2,157] {1,079}	45,222 (9,044) [2,171] {1,085}
Saratoga	13,599	13,668	13,713	13,752	13,879 (2,776) [666] {333}	14,008 (2,802) [672] {336}	14,140 (2,828) [679] {339}
Schenectady	11,917	11,951	11,987	11,998	12,067 (2,413) [579] {290}	12,135 (2,427) [582] {291}	12,201 (2,440) [586] {293}
Suffolk	184,645	185,345	185,911	186,487	187,820 (37,564) [9,015] {4,508}	189,135 (37,827) [9,078] {4,539}	190,422 (38,084) [9,140] {4,570}
Sullivan	5,664	5,691	5,710	5,733	5,807 (1,161) [279] {139}	5,882 (1,176) [282] {141}	5,959 (1,192) [286] {143}
Tompkins	3,932	3,944	3,951	3,956	3,982 (796) [191] {96}	4,007 (801) [192] {96}	4,032 (806) [194] {97}
Ulster	12,205	12,271	12,322	12,378	12,529 (2,506) [601] {301}	12,677 (2,535) [608] {304}	12,827 (2,565) [616] {308}
Westchester	121,124	121,507	121,803	122,066	122,836 (24,567) [5,896] {2,948}	123,600 (24,720) [5,933] {2,966}	124,344 (24,869) [5,969] {2,984}

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.