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

Date: 4/13/21

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 4/13/21 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.

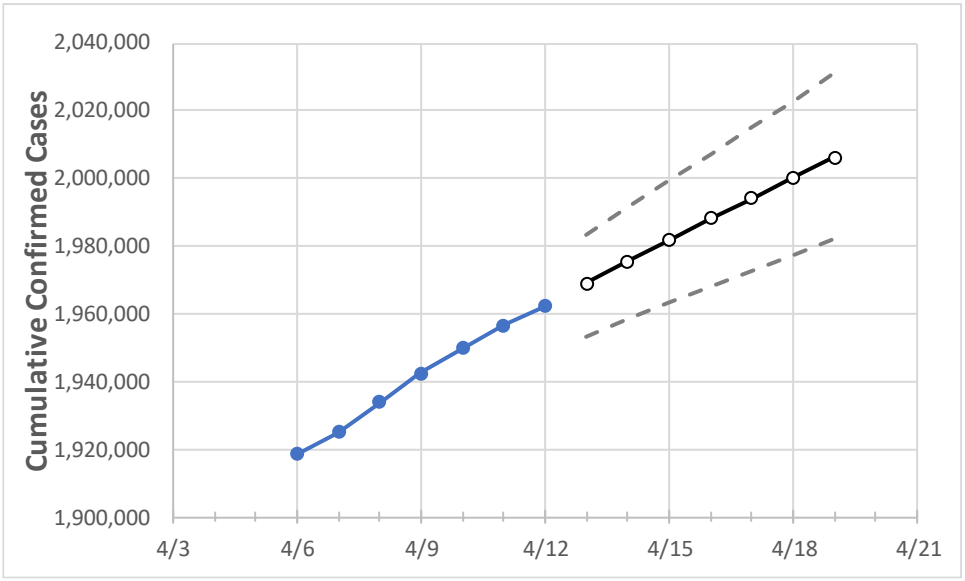
IEM's Modeling Lead

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:						
	4/9	4/10	4/11	4/12	4/13	4/14	4/15	4/16	4/17	4/18	4/19
New York	1,942,469	1,949,964	1,956,594	1,962,225	1,968,898	1,975,445	1,981,839	1,988,127	1,994,240	2,000,302	2,006,114

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:						
	4/9	4/10	4/11	4/12	4/13	4/14	4/15	4/16	4/17	4/18	4/19
Albany	23,149	23,217	23,280	23,323	23,383	23,442	23,500	23,559	23,617	23,674	23,732
Bronx	170,768	171,367	171,900	172,365	172,928	173,485	174,031	174,571	175,096	175,624	176,144
Dutchess	27,142	27,258	27,371	27,449	27,555	27,659	27,764	27,865	27,966	28,064	28,158
Erie	78,193	78,727	79,217	79,580	80,102	80,631	81,168	81,703	82,253	82,801	83,364
Kings	256,399	257,487	258,426	259,343	260,289	261,237	262,165	263,101	264,024	264,935	265,826
Monroe	58,774	59,062	59,315	59,539	59,821	60,116	60,417	60,724	61,042	61,370	61,710
Nassau	173,216	173,772	174,279	174,673	175,225	175,775	176,326	176,854	177,384	177,910	178,428
New York	128,483	129,013	129,488	129,781	130,227	130,671	131,110	131,538	131,952	132,346	132,745
Niagara	17,405	17,527	17,633	17,712	17,837	17,970	18,109	18,254	18,408	18,571	18,736
Onondaga	35,149	35,252	35,353	35,415	35,525	35,638	35,755	35,872	35,993	36,118	36,246
Orange	44,911	45,057	45,194	45,320	45,471	45,622	45,769	45,915	46,057	46,196	46,328
Putnam	9,938	9,969	10,005	10,023	10,063	10,101	10,141	10,179	10,218	10,256	10,293
Queens	256,156	257,160	258,050	258,984	259,938	260,886	261,815	262,728	263,639	264,540	265,417
Rensselaer	10,359	10,402	10,439	10,465	10,502	10,540	10,577	10,613	10,650	10,686	10,722
Richmond	68,593	68,892	69,167	69,440	69,731	70,017	70,308	70,601	70,888	71,178	71,457
Rockland	44,823	44,952	45,068	45,148	45,275	45,404	45,530	45,656	45,777	45,897	46,015
Saratoga	13,944	14,044	14,077	14,122	14,185	14,248	14,311	14,376	14,442	14,506	14,572
Schenectady	12,128	12,157	12,201	12,228	12,262	12,295	12,329	12,363	12,396	12,429	12,463
Suffolk	188,805	189,424	190,014	190,463	191,113	191,761	192,402	193,033	193,658	194,275	194,895
Sullivan	5,864	5,909	5,934	5,958	5,997	6,035	6,074	6,113	6,152	6,191	6,230
Tompkins	3,980	3,988	3,997	4,000	4,006	4,012	4,018	4,023	4,028	4,033	4,037
Ulster	12,588	12,664	12,712	12,755	12,813	12,870	12,928	12,984	13,040	13,095	13,150
Westchester	123,203	123,548	123,838	124,092	124,438	124,771	125,109	125,447	125,770	126,092	126,412

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:		
	4/9	4/10	4/11	4/12	4/14	4/16	4/18
Albany	23,149	23,217	23,280	23,323	23,442 (4,688) [1,125] {563}	23,559 (4,712) [1,131] {565}	23,674 (4,735) [1,136] {568}
Bronx	170,768	171,367	171,900	172,365	173,485 (34,697) [8,327] {4,164}	174,571 (34,914) [8,379] {4,190}	175,624 (35,125) [8,430] {4,215}
Dutchess	27,142	27,258	27,371	27,449	27,659 (5,532) [1,328] {664}	27,865 (5,573) [1,338] {669}	28,064 (5,613) [1,347] {674}
Erie	78,193	78,727	79,217	79,580	80,631 (16,126) [3,870] {1,935}	81,703 (16,341) [3,922] {1,961}	82,801 (16,560) [3,974] {1,987}
Kings	256,399	257,487	258,426	259,343	261,237 (52,247) [12,539] {6,270}	263,101 (52,620) [12,629] {6,314}	264,935 (52,987) [12,717] {6,358}
Monroe	58,774	59,062	59,315	59,539	60,116 (12,023) [2,886] {1,443}	60,724 (12,145) [2,915] {1,457}	61,370 (12,274) [2,946] {1,473}
Nassau	173,216	173,772	174,279	174,673	175,775 (35,155) [8,437] {4,219}	176,854 (35,371) [8,489] {4,244}	177,910 (35,582) [8,540] {4,270}
New York	128,483	129,013	129,488	129,781	130,671 (26,134) [6,272] {3,136}	131,538 (26,308) [6,314] {3,157}	132,346 (26,469) [6,353] {3,176}
Niagara	17,405	17,527	17,633	17,712	17,970 (3,594) [863] {431}	18,254 (3,651) [876] {438}	18,571 (3,714) [891] {446}
Onondaga	35,149	35,252	35,353	35,415	35,638 (7,128) [1,711] {855}	35,872 (7,174) [1,722] {861}	36,118 (7,224) [1,734] {867}
Orange	44,911	45,057	45,194	45,320	45,622 (9,124) [2,190] {1,095}	45,915 (9,183) [2,204] {1,102}	46,196 (9,239) [2,217] {1,109}
Putnam	9,938	9,969	10,005	10,023	10,101 (2,020) [485] {242}	10,179 (2,036) [489] {244}	10,256 (2,051) [492] {246}
Queens	256,156	257,160	258,050	258,984	260,886 (52,177) [12,523] {6,261}	262,728 (52,546) [12,611] {6,305}	264,540 (52,908) [12,698] {6,349}
Rensselaer	10,359	10,402	10,439	10,465	10,540 (2,108) [506] {253}	10,613 (2,123) [509] {255}	10,686 (2,137) [513] {256}
Richmond	68,593	68,892	69,167	69,440	70,017 (14,003) [3,361] {1,680}	70,601 (14,120) [3,389] {1,694}	71,178 (14,236) [3,417] {1,708}
Rockland	44,823	44,952	45,068	45,148	45,404 (9,081) [2,179] {1,090}	45,656 (9,131) [2,191] {1,096}	45,897 (9,179) [2,203] {1,102}
Saratoga	13,944	14,044	14,077	14,122	14,248 (2,850) [684] {342}	14,376 (2,875) [690] {345}	14,506 (2,901) [696] {348}
Schenectady	12,128	12,157	12,201	12,228	12,295 (2,459) [590] {295}	12,363 (2,473) [593] {297}	12,429 (2,486) [597] {298}
Suffolk	188,805	189,424	190,014	190,463	191,761 (38,352) [9,205] {4,602}	193,033 (38,607) [9,266] {4,633}	194,275 (38,855) [9,325] {4,663}
Sullivan	5,864	5,909	5,934	5,958	6,035 (1,207) [290] {145}	6,113 (1,223) [293] {147}	6,191 (1,238) [297] {149}
Tompkins	3,980	3,988	3,997	4,000	4,012 (802) [193] {96}	4,023 (805) [193] {97}	4,033 (807) [194] {97}
Ulster	12,588	12,664	12,712	12,755	12,870 (2,574) [618] {309}	12,984 (2,597) [623] {312}	13,095 (2,619) [629] {314}
Westchester	123,203	123,548	123,838	124,092	124,771 (24,954) [5,989] {2,995}	125,447 (25,089) [6,021] {3,011}	126,092 (25,218) [6,052] {3,026}

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.