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

Date: 12/11/20

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 12/11/20 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.

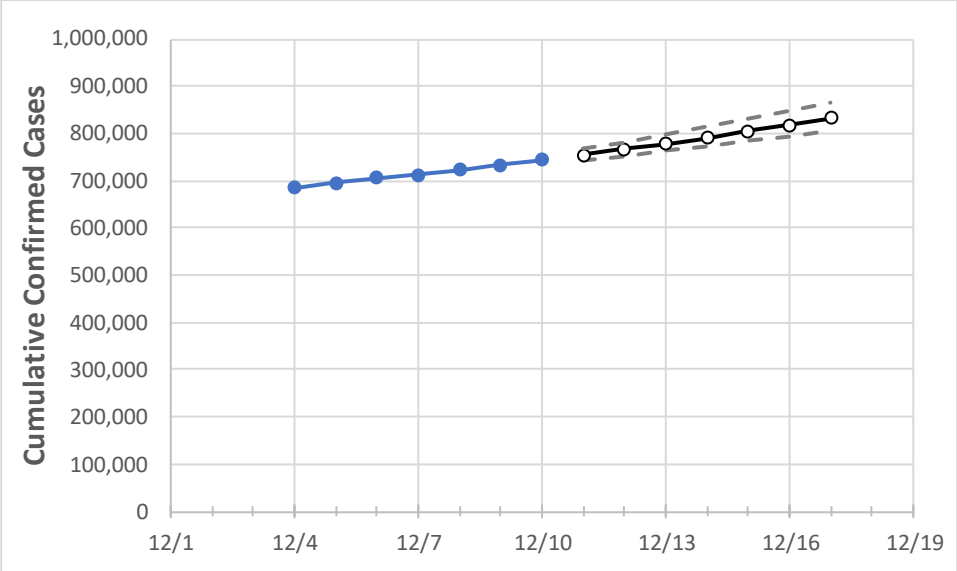
IEM's Modeling Lead

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:						
	12/7	12/8	12/9	12/10	12/11	12/12	12/13	12/14	12/15	12/16	12/17
New York	713,129	722,464	733,064	743,242	754,629	766,437	778,681	791,377	804,539	818,182	832,323

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 20%, and are often within 10%, of actual confirmed cases.

New York Counties

	Actual Confirmed Cases On:				Projected Cases For:						
	12/7	12/8	12/9	12/10	12/11	12/12	12/13	12/14	12/15	12/16	12/17
Albany	6,818	6,991	7,176	7,392	7,589	7,797	8,016	8,247	8,490	8,747	9,018
Bronx	67,754	68,445	69,004	69,540	70,210	70,905	71,626	72,374	73,151	73,956	74,792
Dutchess	8,192	8,339	8,456	8,629	8,795	8,969	9,151	9,343	9,544	9,755	9,976
Erie	29,720	30,073	30,719	31,282	31,880	32,484	33,094	33,710	34,332	34,960	35,595
Kings	95,047	96,020	97,093	98,045	99,133	100,267	101,451	102,685	103,972	105,314	106,714
Monroe	19,518	19,871	20,648	21,267	21,963	22,687	23,441	24,226	25,043	25,893	26,777
Nassau	65,632	66,495	67,203	67,978	68,851	69,758	70,700	71,679	72,696	73,752	74,848
New York	48,962	49,372	49,907	50,419	50,976	51,545	52,127	52,721	53,329	53,950	54,584
Niagara	4,952	5,077	5,266	5,378	5,562	5,755	5,956	6,166	6,385	6,614	6,853
Onondaga	12,941	13,188	13,598	13,945	14,303	14,675	15,061	15,463	15,880	16,314	16,764
Orange	18,349	18,534	18,720	18,923	19,150	19,385	19,629	19,883	20,146	20,420	20,704
Putnam	3,368	3,428	3,489	3,560	3,647	3,738	3,833	3,932	4,037	4,146	4,260
Queens	96,267	97,147	98,294	99,316	100,429	101,590	102,801	104,066	105,385	106,760	108,196
Rensselaer	2,145	2,210	2,269	2,351	2,429	2,512	2,601	2,696	2,797	2,904	3,018
Richmond	25,741	26,248	26,676	27,024	27,502	28,000	28,518	29,059	29,622	30,208	30,818
Rockland	22,897	23,072	23,308	23,505	23,711	23,923	24,142	24,367	24,598	24,836	25,081
Saratoga	2,787	2,888	2,965	3,065	3,165	3,270	3,381	3,499	3,624	3,755	3,894
Schenectady	3,081	3,179	3,272	3,371	3,485	3,607	3,737	3,875	4,022	4,179	4,346
Suffolk	67,860	69,024	69,996	71,043	72,288	73,596	74,967	76,406	77,916	79,499	81,160
Sullivan	2,315	2,326	2,347	2,376	2,394	2,412	2,431	2,450	2,470	2,490	2,511
Tompkins	1,336	1,398	1,424	1,451	1,490	1,530	1,573	1,617	1,663	1,711	1,761
Ulster	3,897	3,974	4,029	4,103	4,191	4,282	4,378	4,479	4,584	4,694	4,810
Westchester	55,187	55,797	56,372	56,995	57,746	58,519	59,316	60,136	60,980	61,850	62,745

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:		
	12/7	12/8	12/9	12/10	12/12	12/14	12/16
Albany	6,818	6,991	7,176	7,392	7,797 (1,559) [374] {187}	8,247 (1,649) [396] {198}	8,747 (1,749) [420] {210}
Bronx	67,754	68,445	69,004	69,540	70,905 (14,181) [3,403] {1,702}	72,374 (14,475) [3,474] {1,737}	73,956 (14,791) [3,550] {1,775}
Dutchess	8,192	8,339	8,456	8,629	8,969 (1,794) [430] {215}	9,343 (1,869) [448] {224}	9,755 (1,951) [468] {234}
Erie	29,720	30,073	30,719	31,282	32,484 (6,497) [1,559] {780}	33,710 (6,742) [1,618] {809}	34,960 (6,992) [1,678] {839}
Kings	95,047	96,020	97,093	98,045	100,267 (20,053) [4,813] {2,406}	102,685 (20,537) [4,929] {2,464}	105,314 (21,063) [5,055] {2,528}
Monroe	19,518	19,871	20,648	21,267	22,687 (4,537) [1,089] {544}	24,226 (4,845) [1,163] {581}	25,893 (5,179) [1,243] {621}
Nassau	65,632	66,495	67,203	67,978	69,758 (13,952) [3,348] {1,674}	71,679 (14,336) [3,441] {1,720}	73,752 (14,750) [3,540] {1,770}
New York	48,962	49,372	49,907	50,419	51,545 (10,309) [2,474] {1,237}	52,721 (10,544) [2,531] {1,265}	53,950 (10,790) [2,590] {1,295}
Niagara	4,952	5,077	5,266	5,378	5,755 (1,151) [276] {138}	6,166 (1,233) [296] {148}	6,614 (1,323) [317] {159}
Onondaga	12,941	13,188	13,598	13,945	14,675 (2,935) [704] {352}	15,463 (3,093) [742] {371}	16,314 (3,263) [783] {392}
Orange	18,349	18,534	18,720	18,923	19,385 (3,877) [930] {465}	19,883 (3,977) [954] {477}	20,420 (4,084) [980] {490}
Putnam	3,368	3,428	3,489	3,560	3,738 (748) [179] {90}	3,932 (786) [189] {94}	4,146 (829) [199] {99}
Queens	96,267	97,147	98,294	99,316	101,590 (20,318) [4,876] {2,438}	104,066 (20,813) [4,995] {2,498}	106,760 (21,352) [5,125] {2,562}
Rensselaer	2,145	2,210	2,269	2,351	2,512 (502) [121] {60}	2,696 (539) [129] {65}	2,904 (581) [139] {70}
Richmond	25,741	26,248	26,676	27,024	28,000 (5,600) [1,344] {672}	29,059 (5,812) [1,395] {697}	30,208 (6,042) [1,450] {725}
Rockland	22,897	23,072	23,308	23,505	23,923 (4,785) [1,148] {574}	24,367 (4,873) [1,170] {585}	24,836 (4,967) [1,192] {596}
Saratoga	2,787	2,888	2,965	3,065	3,270 (654) [157] {78}	3,499 (700) [168] {84}	3,755 (751) [180] {90}
Schenectady	3,081	3,179	3,272	3,371	3,607 (721) [173] {87}	3,875 (775) [186] {93}	4,179 (836) [201] {100}
Suffolk	67,860	69,024	69,996	71,043	73,596 (14,719) [3,533] {1,766}	76,406 (15,281) [3,667] {1,834}	79,499 (15,900) [3,816] {1,908}
Sullivan	2,315	2,326	2,347	2,376	2,412 (482) [116] {58}	2,450 (490) [118] {59}	2,490 (498) [120] {60}
Tompkins	1,336	1,398	1,424	1,451	1,530 (306) [73] {37}	1,617 (323) [78] {39}	1,711 (342) [82] {41}
Ulster	3,897	3,974	4,029	4,103	4,282 (856) [206] {103}	4,479 (896) [215] {107}	4,694 (939) [225] {113}
Westchester	55,187	55,797	56,372	56,995	58,519 (11,704) [2,809] {1,404}	60,136 (12,027) [2,887] {1,443}	61,850 (12,370) [2,969] {1,484}

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.