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

Date: 12/9/20

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 12/9/20 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.

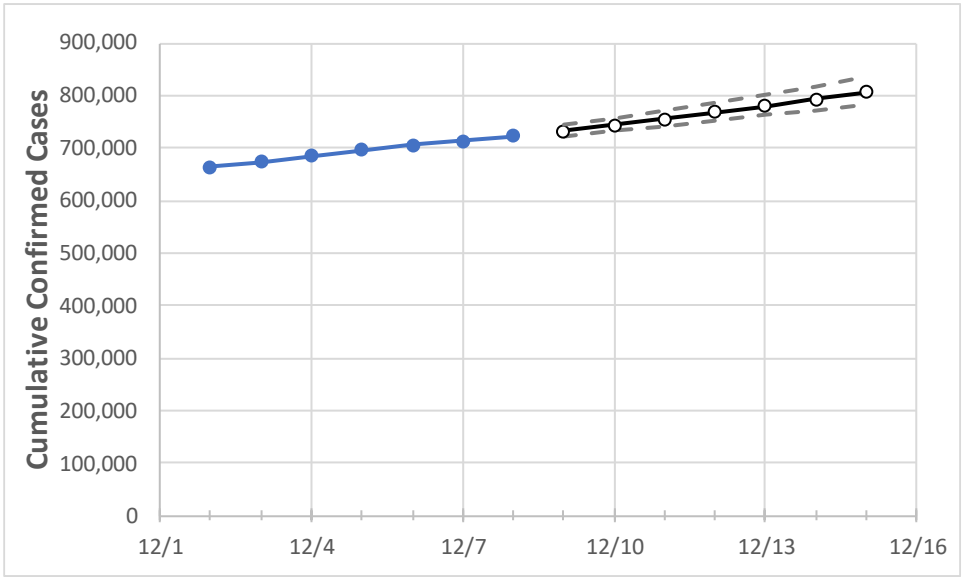
IEM's Modeling Lead

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:						
	12/5	12/6	12/7	12/8	12/9	12/10	12/11	12/12	12/13	12/14	12/15
New York	696,125	705,827	713,129	722,464	733,256	744,467	756,113	768,209	780,771	793,816	807,362

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:						
	12/5	12/6	12/7	12/8	12/9	12/10	12/11	12/12	12/13	12/14	12/15
Albany	6,571	6,711	6,818	6,991	7,163	7,343	7,531	7,728	7,935	8,152	8,379
Bronx	66,682	67,257	67,754	68,445	69,108	69,801	70,524	71,278	72,066	72,888	73,746
Dutchess	7,955	8,099	8,192	8,339	8,494	8,657	8,830	9,012	9,203	9,405	9,618
Erie	28,681	29,337	29,720	30,073	30,668	31,269	31,875	32,487	33,105	33,729	34,359
Kings	93,508	94,312	95,047	96,020	97,033	98,092	99,199	100,355	101,563	102,825	104,144
Monroe	18,453	19,074	19,518	19,871	20,497	21,147	21,822	22,523	23,252	24,009	24,795
Nassau	64,359	65,098	65,632	66,495	67,340	68,221	69,139	70,096	71,092	72,131	73,212
New York	47,994	48,521	48,962	49,372	49,922	50,485	51,063	51,655	52,263	52,886	53,524
Niagara	4,678	4,813	4,952	5,077	5,270	5,474	5,691	5,921	6,165	6,424	6,698
Onondaga	12,358	12,662	12,941	13,188	13,499	13,820	14,152	14,495	14,850	15,216	15,594
Orange	18,018	18,219	18,349	18,534	18,753	18,980	19,217	19,464	19,720	19,987	20,265
Putnam	3,233	3,331	3,368	3,428	3,515	3,608	3,705	3,808	3,916	4,031	4,152
Queens	94,584	95,446	96,267	97,147	98,159	99,213	100,312	101,458	102,653	103,897	105,194
Rensselaer	2,034	2,100	2,145	2,210	2,280	2,355	2,435	2,520	2,610	2,707	2,809
Richmond	25,111	25,470	25,741	26,248	26,713	27,199	27,709	28,242	28,800	29,385	29,996
Rockland	22,633	22,800	22,897	23,072	23,262	23,458	23,659	23,864	24,076	24,293	24,515
Saratoga	2,672	2,734	2,787	2,888	2,981	3,080	3,185	3,297	3,416	3,541	3,675
Schenectady	2,957	3,032	3,081	3,179	3,285	3,399	3,521	3,651	3,791	3,940	4,100
Suffolk	65,993	67,112	67,860	69,024	70,219	71,479	72,809	74,212	75,691	77,251	78,896
Sullivan	2,288	2,302	2,315	2,326	2,341	2,356	2,371	2,386	2,402	2,417	2,433
Tompkins	1,279	1,306	1,336	1,398	1,439	1,483	1,528	1,577	1,627	1,681	1,738
Ulster	3,773	3,858	3,897	3,974	4,066	4,164	4,267	4,377	4,494	4,618	4,749
Westchester	53,944	54,671	55,187	55,797	56,555	57,342	58,159	59,007	59,888	60,802	61,751

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:		
	12/5	12/6	12/7	12/8	12/10	12/12	12/14
Albany	6,571	6,711	6,818	6,991	7,343 (1,469) [352] {176}	7,728 (1,546) [371] {185}	8,152 (1,630) [391] {196}
Bronx	66,682	67,257	67,754	68,445	69,801 (13,960) [3,350] {1,675}	71,278 (14,256) [3,421] {1,711}	72,888 (14,578) [3,499] {1,749}
Dutchess	7,955	8,099	8,192	8,339	8,657 (1,731) [416] {208}	9,012 (1,802) [433] {216}	9,405 (1,881) [451] {226}
Erie	28,681	29,337	29,720	30,073	31,269 (6,254) [1,501] {750}	32,487 (6,497) [1,559] {780}	33,729 (6,746) [1,619] {809}
Kings	93,508	94,312	95,047	96,020	98,092 (19,618) [4,708] {2,354}	100,355 (20,071) [4,817] {2,409}	102,825 (20,565) [4,936] {2,468}
Monroe	18,453	19,074	19,518	19,871	21,147 (4,229) [1,015] {508}	22,523 (4,505) [1,081] {541}	24,009 (4,802) [1,152] {576}
Nassau	64,359	65,098	65,632	66,495	68,221 (13,644) [3,275] {1,637}	70,096 (14,019) [3,365] {1,682}	72,131 (14,426) [3,462] {1,731}
New York	47,994	48,521	48,962	49,372	50,485 (10,097) [2,423] {1,212}	51,655 (10,331) [2,479] {1,240}	52,886 (10,577) [2,539] {1,269}
Niagara	4,678	4,813	4,952	5,077	5,474 (1,095) [263] {131}	5,921 (1,184) [284] {142}	6,424 (1,285) [308] {154}
Onondaga	12,358	12,662	12,941	13,188	13,820 (2,764) [663] {332}	14,495 (2,899) [696] {348}	15,216 (3,043) [730] {365}
Orange	18,018	18,219	18,349	18,534	18,980 (3,796) [911] {456}	19,464 (3,893) [934] {467}	19,987 (3,997) [959] {480}
Putnam	3,233	3,331	3,368	3,428	3,608 (722) [173] {87}	3,808 (762) [183] {91}	4,031 (806) [193] {97}
Queens	94,584	95,446	96,267	97,147	99,213 (19,843) [4,762] {2,381}	101,458 (20,292) [4,870] {2,435}	103,897 (20,779) [4,987] {2,494}
Rensselaer	2,034	2,100	2,145	2,210	2,355 (471) [113] {57}	2,520 (504) [121] {60}	2,707 (541) [130] {65}
Richmond	25,111	25,470	25,741	26,248	27,199 (5,440) [1,306] {653}	28,242 (5,648) [1,356] {678}	29,385 (5,877) [1,410] {705}
Rockland	22,633	22,800	22,897	23,072	23,458 (4,692) [1,126] {563}	23,864 (4,773) [1,145] {573}	24,293 (4,859) [1,166] {583}
Saratoga	2,672	2,734	2,787	2,888	3,080 (616) [148] {74}	3,297 (659) [158] {79}	3,541 (708) [170] {85}
Schenectady	2,957	3,032	3,081	3,179	3,399 (680) [163] {82}	3,651 (730) [175] {88}	3,940 (788) [189] {95}
Suffolk	65,993	67,112	67,860	69,024	71,479 (14,296) [3,431] {1,716}	74,212 (14,842) [3,562] {1,781}	77,251 (15,450) [3,708] {1,854}
Sullivan	2,288	2,302	2,315	2,326	2,356 (471) [113] {57}	2,386 (477) [115] {57}	2,417 (483) [116] {58}
Tompkins	1,279	1,306	1,336	1,398	1,483 (297) [71] {36}	1,577 (315) [76] {38}	1,681 (336) [81] {40}
Ulster	3,773	3,858	3,897	3,974	4,164 (833) [200] {100}	4,377 (875) [210] {105}	4,618 (924) [222] {111}
Westchester	53,944	54,671	55,187	55,797	57,342 (11,468) [2,752] {1,376}	59,007 (11,801) [2,832] {1,416}	60,802 (12,160) [2,919] {1,459}

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.