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

Date: 3/15/21

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 3/15/21 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.

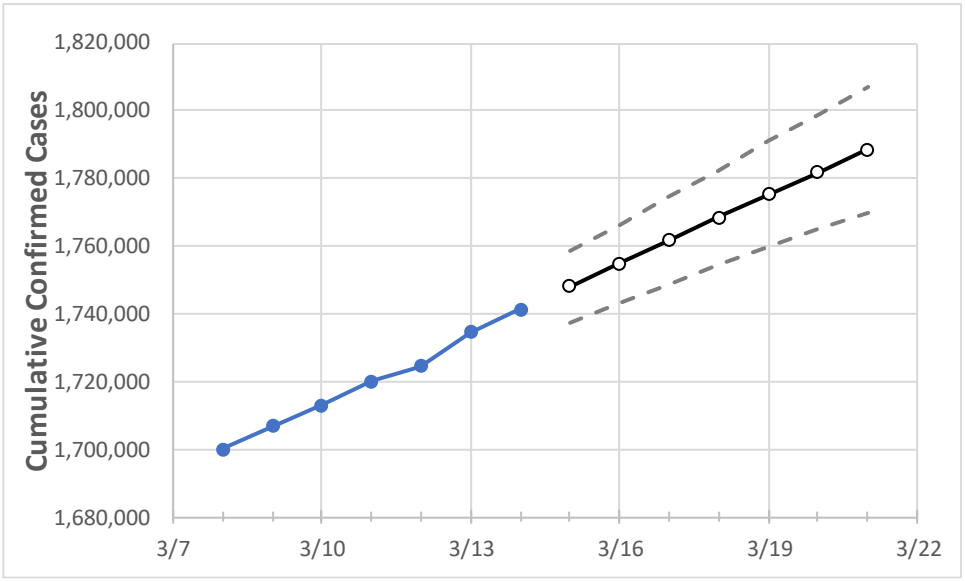
IEM's Modeling Lead

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:						
	3/11	3/12	3/13	3/14	3/15	3/16	3/17	3/18	3/19	3/20	3/21
New York	1,720,199	1,724,425	1,734,676	1,741,363	1,748,219	1,755,024	1,761,851	1,768,535	1,775,242	1,781,943	1,788,592

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:						
	3/11	3/12	3/13	3/14	3/15	3/16	3/17	3/18	3/19	3/20	3/21
Albany	21,468	21,510	21,551	21,595	21,646	21,697	21,747	21,796	21,846	21,894	21,942
Bronx	151,512	152,298	152,826	153,464	154,098	154,727	155,352	155,953	156,553	157,140	157,736
Dutchess	23,439	23,573	23,706	23,770	23,874	23,981	24,084	24,192	24,295	24,402	24,507
Erie	67,583	67,831	68,079	68,325	68,539	68,752	68,965	69,176	69,384	69,594	69,798
Kings	222,464	223,800	224,687	225,924	227,047	228,177	229,295	230,434	231,554	232,659	233,781
Monroe	53,822	53,933	54,044	54,163	54,268	54,371	54,474	54,577	54,676	54,774	54,870
Nassau	154,867	155,588	156,309	156,822	157,439	158,059	158,674	159,291	159,900	160,517	161,129
New York	109,618	110,289	110,727	111,336	111,893	112,442	113,001	113,551	114,093	114,631	115,152
Niagara	15,670	15,708	15,746	15,781	15,814	15,846	15,878	15,910	15,942	15,972	16,003
Onondaga	32,998	33,053	33,107	33,162	33,211	33,258	33,306	33,354	33,399	33,445	33,489
Orange	38,859	39,074	39,288	39,462	39,653	39,848	40,040	40,234	40,433	40,632	40,835
Putnam	8,691	8,730	8,768	8,795	8,828	8,861	8,894	8,926	8,960	8,993	9,027
Queens	222,479	223,654	224,485	225,580	226,607	227,615	228,610	229,608	230,615	231,611	232,585
Rensselaer	9,342	9,375	9,408	9,450	9,481	9,512	9,543	9,573	9,604	9,636	9,668
Richmond	59,941	60,215	60,423	60,706	60,982	61,259	61,537	61,812	62,087	62,363	62,636
Rockland	40,407	40,583	40,758	40,870	41,052	41,234	41,416	41,603	41,793	41,986	42,176
Saratoga	12,371	12,418	12,465	12,503	12,543	12,582	12,621	12,660	12,699	12,739	12,779
Schenectady	11,125	11,159	11,192	11,220	11,247	11,274	11,301	11,328	11,355	11,382	11,408
Suffolk	168,764	169,495	170,226	170,738	171,349	171,955	172,588	173,206	173,824	174,446	175,062
Sullivan	4,938	4,967	4,995	5,017	5,037	5,057	5,077	5,097	5,117	5,137	5,158
Tompkins	3,571	3,586	3,601	3,614	3,626	3,638	3,651	3,663	3,676	3,689	3,702
Ulster	10,523	10,607	10,690	10,747	10,811	10,877	10,945	11,015	11,087	11,162	11,240
Westchester	111,713	112,140	112,567	112,854	113,214	113,572	113,923	114,271	114,616	114,962	115,301

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:		
	3/11	3/12	3/13	3/14	3/16	3/18	3/20
Albany	21,468	21,510	21,551	21,595	21,697 (4,339) [1,041] {521}	21,796 (4,359) [1,046] {523}	21,894 (4,379) [1,051] {525}
Bronx	151,512	152,298	152,826	153,464	154,727 (30,945) [7,427] {3,713}	155,953 (31,191) [7,486] {3,743}	157,140 (31,428) [7,543] {3,771}
Dutchess	23,439	23,573	23,706	23,770	23,981 (4,796) [1,151] {576}	24,192 (4,838) [1,161] {581}	24,402 (4,880) [1,171] {586}
Erie	67,583	67,831	68,079	68,325	68,752 (13,750) [3,300] {1,650}	69,176 (13,835) [3,320] {1,660}	69,594 (13,919) [3,341] {1,670}
Kings	222,464	223,800	224,687	225,924	228,177 (45,635) [10,952] {5,476}	230,434 (46,087) [11,061] {5,530}	232,659 (46,532) [11,168] {5,584}
Monroe	53,822	53,933	54,044	54,163	54,371 (10,874) [2,610] {1,305}	54,577 (10,915) [2,620] {1,310}	54,774 (10,955) [2,629] {1,315}
Nassau	154,867	155,588	156,309	156,822	158,059 (31,612) [7,587] {3,793}	159,291 (31,858) [7,646] {3,823}	160,517 (32,103) [7,705] {3,852}
New York	109,618	110,289	110,727	111,336	112,442 (22,488) [5,397] {2,699}	113,551 (22,710) [5,450] {2,725}	114,631 (22,926) [5,502] {2,751}
Niagara	15,670	15,708	15,746	15,781	15,846 (3,169) [761] {380}	15,910 (3,182) [764] {382}	15,972 (3,194) [767] {383}
Onondaga	32,998	33,053	33,107	33,162	33,258 (6,652) [1,596] {798}	33,354 (6,671) [1,601] {800}	33,445 (6,689) [1,605] {803}
Orange	38,859	39,074	39,288	39,462	39,848 (7,970) [1,913] {956}	40,234 (8,047) [1,931] {966}	40,632 (8,126) [1,950] {975}
Putnam	8,691	8,730	8,768	8,795	8,861 (1,772) [425] {213}	8,926 (1,785) [428] {214}	8,993 (1,799) [432] {216}
Queens	222,479	223,654	224,485	225,580	227,615 (45,523) [10,926] {5,463}	229,608 (45,922) [11,021] {5,511}	231,611 (46,322) [11,117] {5,559}
Rensselaer	9,342	9,375	9,408	9,450	9,512 (1,902) [457] {228}	9,573 (1,915) [460] {230}	9,636 (1,927) [463] {231}
Richmond	59,941	60,215	60,423	60,706	61,259 (12,252) [2,940] {1,470}	61,812 (12,362) [2,967] {1,483}	62,363 (12,473) [2,993] {1,497}
Rockland	40,407	40,583	40,758	40,870	41,234 (8,247) [1,979] {990}	41,603 (8,321) [1,997] {998}	41,986 (8,397) [2,015] {1,008}
Saratoga	12,371	12,418	12,465	12,503	12,582 (2,516) [604] {302}	12,660 (2,532) [608] {304}	12,739 (2,548) [611] {306}
Schenectady	11,125	11,159	11,192	11,220	11,274 (2,255) [541] {271}	11,328 (2,266) [544] {272}	11,382 (2,276) [546] {273}
Suffolk	168,764	169,495	170,226	170,738	171,955 (34,391) [8,254] {4,127}	173,206 (34,641) [8,314] {4,157}	174,446 (34,889) [8,373] {4,187}
Sullivan	4,938	4,967	4,995	5,017	5,057 (1,011) [243] {121}	5,097 (1,019) [245] {122}	5,137 (1,027) [247] {123}
Tompkins	3,571	3,586	3,601	3,614	3,638 (728) [175] {87}	3,663 (733) [176] {88}	3,689 (738) [177] {89}
Ulster	10,523	10,607	10,690	10,747	10,877 (2,175) [522] {261}	11,015 (2,203) [529] {264}	11,162 (2,232) [536] {268}
Westchester	111,713	112,140	112,567	112,854	113,572 (22,714) [5,451] {2,726}	114,271 (22,854) [5,485] {2,743}	114,962 (22,992) [5,518] {2,759}

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.