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

Date: 3/2/21

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 3/2/21 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.

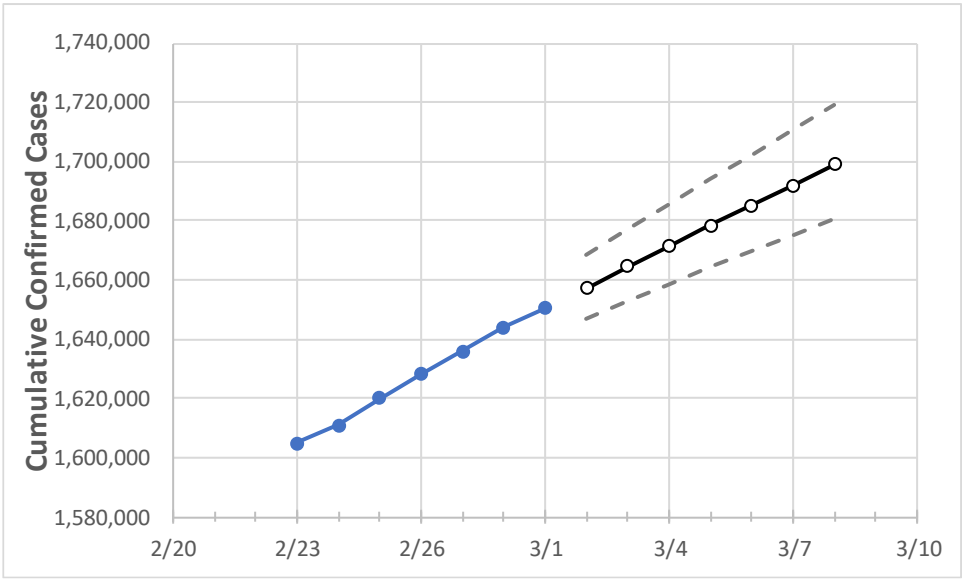
IEM's Modeling Lead

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:						
	2/26	2/27	2/28	3/1	3/2	3/3	3/4	3/5	3/6	3/7	3/8
New York	1,627,998	1,636,040	1,643,867	1,650,303	1,657,358	1,664,494	1,671,490	1,678,408	1,685,304	1,692,036	1,698,939

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:						
	2/26	2/27	2/28	3/1	3/2	3/3	3/4	3/5	3/6	3/7	3/8
Albany	20,683	20,758	20,848	20,890	20,938	20,987	21,033	21,078	21,123	21,168	21,213
Bronx	142,069	142,935	143,814	144,519	145,299	146,067	146,843	147,612	148,354	149,082	149,823
Dutchess	22,088	22,190	22,297	22,387	22,488	22,588	22,688	22,786	22,884	22,982	23,077
Erie	64,689	64,963	65,215	65,419	65,643	65,865	66,085	66,303	66,527	66,744	66,955
Kings	207,366	208,629	209,868	210,950	212,139	213,339	214,535	215,726	216,891	218,080	219,251
Monroe	52,245	52,371	52,543	52,679	52,807	52,933	53,058	53,182	53,303	53,422	53,539
Nassau	146,727	147,472	148,110	148,669	149,239	149,802	150,360	150,922	151,471	152,011	152,563
New York	101,934	102,643	103,289	103,922	104,539	105,171	105,782	106,407	107,012	107,635	108,249
Niagara	15,194	15,240	15,295	15,324	15,357	15,389	15,421	15,452	15,481	15,511	15,539
Onondaga	32,224	32,312	32,410	32,452	32,506	32,559	32,612	32,662	32,713	32,762	32,809
Orange	36,556	36,747	36,952	37,059	37,222	37,387	37,550	37,712	37,877	38,042	38,203
Putnam	8,271	8,307	8,340	8,369	8,398	8,426	8,455	8,483	8,511	8,538	8,565
Queens	208,445	209,641	210,793	211,812	212,899	213,977	215,066	216,121	217,173	218,208	219,247
Rensselaer	8,935	8,965	9,013	9,039	9,066	9,094	9,121	9,148	9,173	9,200	9,225
Richmond	56,406	56,649	56,938	57,201	57,451	57,694	57,938	58,180	58,422	58,662	58,902
Rockland	38,265	38,416	38,538	38,628	38,747	38,866	38,985	39,102	39,217	39,332	39,443
Saratoga	11,844	11,889	11,939	11,970	12,012	12,054	12,095	12,137	12,179	12,220	12,262
Schenectady	10,765	10,790	10,827	10,842	10,861	10,879	10,897	10,914	10,931	10,946	10,961
Suffolk	160,967	161,632	162,243	162,818	163,345	163,881	164,410	164,933	165,450	165,952	166,452
Sullivan	4,715	4,730	4,741	4,755	4,773	4,790	4,808	4,825	4,842	4,859	4,877
Tompkins	3,435	3,441	3,452	3,457	3,463	3,469	3,475	3,480	3,485	3,490	3,495
Ulster	9,940	9,981	10,037	10,069	10,107	10,146	10,184	10,221	10,258	10,294	10,331
Westchester	106,611	107,075	107,487	107,857	108,280	108,701	109,124	109,548	109,967	110,381	110,796

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:		
	2/26	2/27	2/28	3/1	3/3	3/5	3/7
Albany	20,683	20,758	20,848	20,890	20,987 (4,197) [1,007] {504}	21,078 (4,216) [1,012] {506}	21,168 (4,234) [1,016] {508}
Bronx	142,069	142,935	143,814	144,519	146,067 (29,213) [7,011] {3,506}	147,612 (29,522) [7,085] {3,543}	149,082 (29,816) [7,156] {3,578}
Dutchess	22,088	22,190	22,297	22,387	22,588 (4,518) [1,084] {542}	22,786 (4,557) [1,094] {547}	22,982 (4,596) [1,103] {552}
Erie	64,689	64,963	65,215	65,419	65,865 (13,173) [3,162] {1,581}	66,303 (13,261) [3,183] {1,591}	66,744 (13,349) [3,204] {1,602}
Kings	207,366	208,629	209,868	210,950	213,339 (42,668) [10,240] {5,120}	215,726 (43,145) [10,355] {5,177}	218,080 (43,616) [10,468] {5,234}
Monroe	52,245	52,371	52,543	52,679	52,933 (10,587) [2,541] {1,270}	53,182 (10,636) [2,553] {1,276}	53,422 (10,684) [2,564] {1,282}
Nassau	146,727	147,472	148,110	148,669	149,802 (29,960) [7,190] {3,595}	150,922 (30,184) [7,244] {3,622}	152,011 (30,402) [7,297] {3,648}
New York	101,934	102,643	103,289	103,922	105,171 (21,034) [5,048] {2,524}	106,407 (21,281) [5,108] {2,554}	107,635 (21,527) [5,166] {2,583}
Niagara	15,194	15,240	15,295	15,324	15,389 (3,078) [739] {369}	15,452 (3,090) [742] {371}	15,511 (3,102) [745] {372}
Onondaga	32,224	32,312	32,410	32,452	32,559 (6,512) [1,563] {781}	32,662 (6,532) [1,568] {784}	32,762 (6,552) [1,573] {786}
Orange	36,556	36,747	36,952	37,059	37,387 (7,477) [1,795] {897}	37,712 (7,542) [1,810] {905}	38,042 (7,608) [1,826] {913}
Putnam	8,271	8,307	8,340	8,369	8,426 (1,685) [404] {202}	8,483 (1,697) [407] {204}	8,538 (1,708) [410] {205}
Queens	208,445	209,641	210,793	211,812	213,977 (42,795) [10,271] {5,135}	216,121 (43,224) [10,374] {5,187}	218,208 (43,642) [10,474] {5,237}
Rensselaer	8,935	8,965	9,013	9,039	9,094 (1,819) [437] {218}	9,148 (1,830) [439] {220}	9,200 (1,840) [442] {221}
Richmond	56,406	56,649	56,938	57,201	57,694 (11,539) [2,769] {1,385}	58,180 (11,636) [2,793] {1,396}	58,662 (11,732) [2,816] {1,408}
Rockland	38,265	38,416	38,538	38,628	38,866 (7,773) [1,866] {933}	39,102 (7,820) [1,877] {938}	39,332 (7,866) [1,888] {944}
Saratoga	11,844	11,889	11,939	11,970	12,054 (2,411) [579] {289}	12,137 (2,427) [583] {291}	12,220 (2,444) [587] {293}
Schenectady	10,765	10,790	10,827	10,842	10,879 (2,176) [522] {261}	10,914 (2,183) [524] {262}	10,946 (2,189) [525] {263}
Suffolk	160,967	161,632	162,243	162,818	163,881 (32,776) [7,866] {3,933}	164,933 (32,987) [7,917] {3,958}	165,952 (33,190) [7,966] {3,983}
Sullivan	4,715	4,730	4,741	4,755	4,790 (958) [230] {115}	4,825 (965) [232] {116}	4,859 (972) [233] {117}
Tompkins	3,435	3,441	3,452	3,457	3,469 (694) [167] {83}	3,480 (696) [167] {84}	3,490 (698) [168] {84}
Ulster	9,940	9,981	10,037	10,069	10,146 (2,029) [487] {244}	10,221 (2,044) [491] {245}	10,294 (2,059) [494] {247}
Westchester	106,611	107,075	107,487	107,857	108,701 (21,740) [5,218] {2,609}	109,548 (21,910) [5,258] {2,629}	110,381 (22,076) [5,298] {2,649}

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.