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

Date: 2/24/21

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 2/24/21 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.

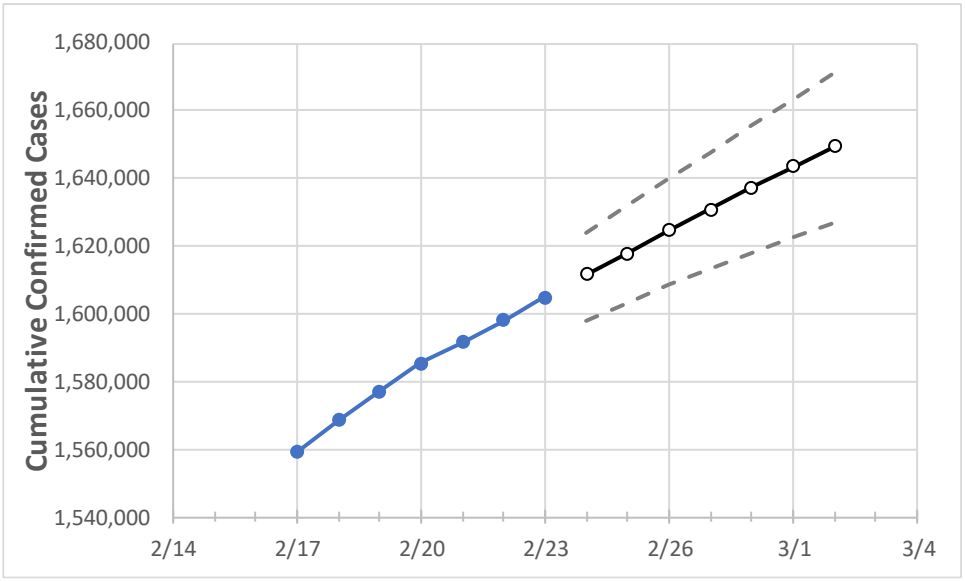
IEM's Modeling Lead

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:						
	2/20	2/21	2/22	2/23	2/24	2/25	2/26	2/27	2/28	3/1	3/2
New York	1,585,435	1,591,672	1,597,969	1,604,892	1,611,536	1,618,008	1,624,608	1,631,026	1,637,290	1,643,465	1,649,445

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:						
	2/20	2/21	2/22	2/23	2/24	2/25	2/26	2/27	2/28	3/1	3/2
Albany	20,336	20,392	20,441	20,486	20,532	20,576	20,618	20,658	20,697	20,735	20,772
Bronx	137,641	138,191	138,924	139,731	140,517	141,325	142,108	142,893	143,675	144,442	145,231
Dutchess	21,452	21,565	21,656	21,769	21,864	21,960	22,055	22,148	22,244	22,335	22,427
Erie	63,248	63,468	63,678	63,863	64,092	64,314	64,536	64,753	64,962	65,167	65,370
Kings	200,493	201,409	202,392	203,458	204,551	205,654	206,719	207,772	208,819	209,890	210,909
Monroe	51,423	51,564	51,674	51,802	51,927	52,047	52,161	52,274	52,383	52,489	52,589
Nassau	143,069	143,615	144,131	144,771	145,308	145,838	146,362	146,869	147,367	147,852	148,325
New York	98,438	98,989	99,552	100,143	100,732	101,332	101,921	102,509	103,105	103,689	104,271
Niagara	14,957	14,984	15,012	15,059	15,092	15,122	15,154	15,183	15,211	15,237	15,264
Onondaga	31,848	31,909	31,954	32,017	32,072	32,124	32,175	32,223	32,270	32,314	32,356
Orange	35,496	35,648	35,755	35,925	36,064	36,203	36,337	36,468	36,598	36,730	36,856
Putnam	8,085	8,116	8,135	8,154	8,181	8,207	8,232	8,256	8,279	8,302	8,323
Queens	202,250	203,097	204,066	205,182	206,248	207,321	208,361	209,415	210,426	211,416	212,434
Rensselaer	8,760	8,788	8,810	8,839	8,865	8,889	8,913	8,936	8,959	8,980	9,000
Richmond	55,023	55,168	55,424	55,652	55,894	56,130	56,366	56,598	56,829	57,055	57,275
Rockland	37,478	37,579	37,674	37,833	37,952	38,068	38,185	38,300	38,415	38,527	38,636
Saratoga	11,560	11,604	11,642	11,687	11,719	11,751	11,782	11,812	11,840	11,868	11,894
Schenectady	10,593	10,624	10,645	10,661	10,682	10,701	10,720	10,738	10,755	10,772	10,787
Suffolk	157,516	158,029	158,592	159,146	159,648	160,131	160,610	161,076	161,551	161,989	162,426
Sullivan	4,594	4,616	4,629	4,646	4,661	4,677	4,693	4,707	4,722	4,737	4,752
Tompkins	3,376	3,389	3,398	3,408	3,417	3,426	3,434	3,442	3,450	3,458	3,465
Ulster	9,698	9,754	9,780	9,812	9,846	9,879	9,912	9,944	9,975	10,006	10,036
Westchester	103,990	104,400	104,777	105,168	105,547	105,920	106,284	106,640	106,989	107,328	107,660

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:		
	2/20	2/21	2/22	2/23	2/25	2/27	3/1
Albany	20,336	20,392	20,441	20,486	20,576 (4,115) [988] {494}	20,658 (4,132) [992] {496}	20,735 (4,147) [995] {498}
Bronx	137,641	138,191	138,924	139,731	141,325 (28,265) [6,784] {3,392}	142,893 (28,579) [6,859] {3,429}	144,442 (28,888) [6,933] {3,467}
Dutchess	21,452	21,565	21,656	21,769	21,960 (4,392) [1,054] {527}	22,148 (4,430) [1,063] {532}	22,335 (4,467) [1,072] {536}
Erie	63,248	63,468	63,678	63,863	64,314 (12,863) [3,087] {1,544}	64,753 (12,951) [3,108] {1,554}	65,167 (13,033) [3,128] {1,564}
Kings	200,493	201,409	202,392	203,458	205,654 (41,131) [9,871] {4,936}	207,772 (41,554) [9,973] {4,987}	209,890 (41,978) [10,075] {5,037}
Monroe	51,423	51,564	51,674	51,802	52,047 (10,409) [2,498] {1,249}	52,274 (10,455) [2,509] {1,255}	52,489 (10,498) [2,519] {1,260}
Nassau	143,069	143,615	144,131	144,771	145,838 (29,168) [7,000] {3,500}	146,869 (29,374) [7,050] {3,525}	147,852 (29,570) [7,097] {3,548}
New York	98,438	98,989	99,552	100,143	101,332 (20,266) [4,864] {2,432}	102,509 (20,502) [4,920] {2,460}	103,689 (20,738) [4,977] {2,489}
Niagara	14,957	14,984	15,012	15,059	15,122 (3,024) [726] {363}	15,183 (3,037) [729] {364}	15,237 (3,047) [731] {366}
Onondaga	31,848	31,909	31,954	32,017	32,124 (6,425) [1,542] {771}	32,223 (6,445) [1,547] {773}	32,314 (6,463) [1,551] {776}
Orange	35,496	35,648	35,755	35,925	36,203 (7,241) [1,738] {869}	36,468 (7,294) [1,750] {875}	36,730 (7,346) [1,763] {882}
Putnam	8,085	8,116	8,135	8,154	8,207 (1,641) [394] {197}	8,256 (1,651) [396] {198}	8,302 (1,660) [398] {199}
Queens	202,250	203,097	204,066	205,182	207,321 (41,464) [9,951] {4,976}	209,415 (41,883) [10,052] {5,026}	211,416 (42,283) [10,148] {5,074}
Rensselaer	8,760	8,788	8,810	8,839	8,889 (1,778) [427] {213}	8,936 (1,787) [429] {214}	8,980 (1,796) [431] {216}
Richmond	55,023	55,168	55,424	55,652	56,130 (11,226) [2,694] {1,347}	56,598 (11,320) [2,717] {1,358}	57,055 (11,411) [2,739] {1,369}
Rockland	37,478	37,579	37,674	37,833	38,068 (7,614) [1,827] {914}	38,300 (7,660) [1,838] {919}	38,527 (7,705) [1,849] {925}
Saratoga	11,560	11,604	11,642	11,687	11,751 (2,350) [564] {282}	11,812 (2,362) [567] {283}	11,868 (2,374) [570] {285}
Schenectady	10,593	10,624	10,645	10,661	10,701 (2,140) [514] {257}	10,738 (2,148) [515] {258}	10,772 (2,154) [517] {259}
Suffolk	157,516	158,029	158,592	159,146	160,131 (32,026) [7,686] {3,843}	161,076 (32,215) [7,732] {3,866}	161,989 (32,398) [7,775] {3,888}
Sullivan	4,594	4,616	4,629	4,646	4,677 (935) [224] {112}	4,707 (941) [226] {113}	4,737 (947) [227] {114}
Tompkins	3,376	3,389	3,398	3,408	3,426 (685) [164] {82}	3,442 (688) [165] {83}	3,458 (692) [166] {83}
Ulster	9,698	9,754	9,780	9,812	9,879 (1,976) [474] {237}	9,944 (1,989) [477] {239}	10,006 (2,001) [480] {240}
Westchester	103,990	104,400	104,777	105,168	105,920 (21,184) [5,084] {2,542}	106,640 (21,328) [5,119] {2,559}	107,328 (21,466) [5,152] {2,576}

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.