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

Date: 4/2/21

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 4/2/21 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.

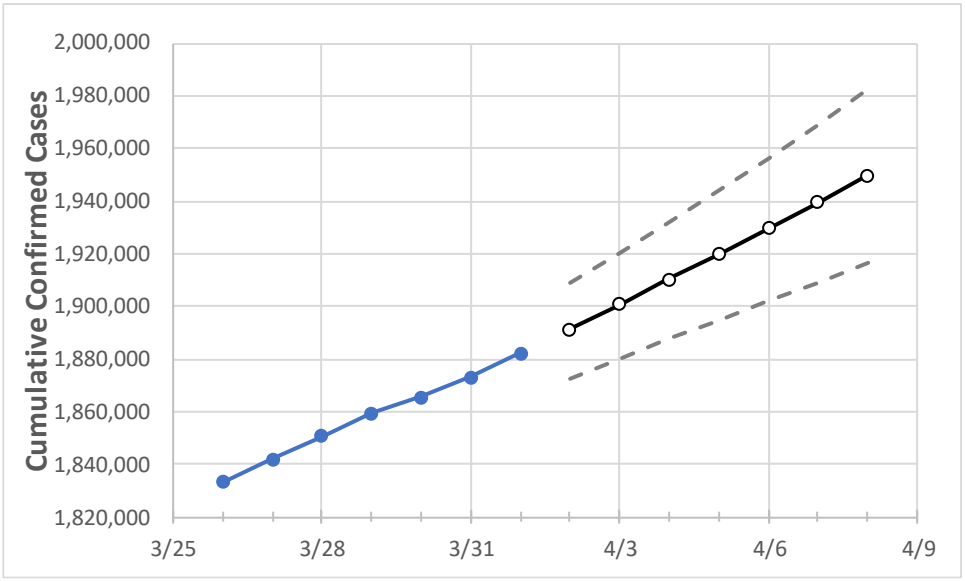
IEM's Modeling Lead

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:						
	3/29	3/30	3/31	4/1	4/2	4/3	4/4	4/5	4/6	4/7	4/8
New York	1,859,474	1,865,349	1,873,138	1,882,308	1,891,421	1,900,762	1,910,216	1,919,682	1,929,478	1,939,470	1,949,593

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:						
	3/29	3/30	3/31	4/1	4/2	4/3	4/4	4/5	4/6	4/7	4/8
Albany	22,476	22,536	22,613	22,696	22,767	22,841	22,916	22,992	23,070	23,149	23,229
Bronx	163,984	164,369	164,950	165,792	166,557	167,362	168,153	168,942	169,737	170,560	171,393
Dutchess	25,807	25,893	26,044	26,230	26,377	26,523	26,673	26,825	26,977	27,129	27,283
Erie	73,171	73,561	73,990	74,496	74,962	75,444	75,946	76,459	76,994	77,553	78,115
Kings	244,802	245,458	246,486	247,752	249,121	250,523	251,899	253,300	254,723	256,161	257,587
Monroe	56,399	56,535	56,688	56,881	57,066	57,251	57,442	57,639	57,841	58,046	58,252
Nassau	166,365	166,881	167,557	168,246	168,875	169,500	170,130	170,758	171,393	172,024	172,658
New York	122,271	122,759	123,363	124,020	124,796	125,640	126,474	127,310	128,144	129,019	129,877
Niagara	16,399	16,490	16,540	16,639	16,704	16,772	16,843	16,917	16,995	17,074	17,159
Onondaga	34,127	34,176	34,235	34,328	34,403	34,479	34,555	34,633	34,711	34,791	34,873
Orange	42,769	43,015	43,231	43,483	43,730	43,977	44,232	44,488	44,744	45,002	45,264
Putnam	9,438	9,468	9,527	9,563	9,613	9,662	9,713	9,766	9,818	9,872	9,926
Queens	244,365	245,105	246,197	247,653	249,063	250,511	251,976	253,445	254,894	256,393	257,882
Rensselaer	9,931	9,973	10,004	10,053	10,093	10,132	10,173	10,214	10,256	10,298	10,342
Richmond	65,304	65,516	65,796	66,184	66,544	66,911	67,279	67,650	68,038	68,432	68,826
Rockland	43,237	43,375	43,585	43,718	43,875	44,035	44,192	44,349	44,510	44,673	44,834
Saratoga	13,275	13,338	13,389	13,449	13,513	13,577	13,642	13,708	13,776	13,845	13,915
Schenectady	11,737	11,775	11,822	11,854	11,898	11,942	11,987	12,033	12,082	12,132	12,182
Suffolk	181,006	181,618	182,442	183,206	183,956	184,717	185,483	186,245	187,023	187,803	188,581
Sullivan	5,449	5,482	5,535	5,576	5,616	5,657	5,700	5,745	5,789	5,837	5,885
Tompkins	3,866	3,878	3,894	3,913	3,932	3,952	3,971	3,991	4,012	4,033	4,053
Ulster	11,859	11,918	11,979	12,058	12,142	12,226	12,313	12,400	12,486	12,574	12,664
Westchester	118,964	119,242	119,732	120,316	120,789	121,274	121,770	122,276	122,792	123,311	123,849

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:		
	3/29	3/30	3/31	4/1	4/3	4/5	4/7
Albany	22,476	22,536	22,613	22,696	22,841 (4,568) [1,096] {548}	22,992 (4,598) [1,104] {552}	23,149 (4,630) [1,111] {556}
Bronx	163,984	164,369	164,950	165,792	167,362 (33,472) [8,033] {4,017}	168,942 (33,788) [8,109] {4,055}	170,560 (34,112) [8,187] {4,093}
Dutchess	25,807	25,893	26,044	26,230	26,523 (5,305) [1,273] {637}	26,825 (5,365) [1,288] {644}	27,129 (5,426) [1,302] {651}
Erie	73,171	73,561	73,990	74,496	75,444 (15,089) [3,621] {1,811}	76,459 (15,292) [3,670] {1,835}	77,553 (15,511) [3,723] {1,861}
Kings	244,802	245,458	246,486	247,752	250,523 (50,105) [12,025] {6,013}	253,300 (50,660) [12,158] {6,079}	256,161 (51,232) [12,296] {6,148}
Monroe	56,399	56,535	56,688	56,881	57,251 (11,450) [2,748] {1,374}	57,639 (11,528) [2,767] {1,383}	58,046 (11,609) [2,786] {1,393}
Nassau	166,365	166,881	167,557	168,246	169,500 (33,900) [8,136] {4,068}	170,758 (34,152) [8,196] {4,098}	172,024 (34,405) [8,257] {4,129}
New York	122,271	122,759	123,363	124,020	125,640 (25,128) [6,031] {3,015}	127,310 (25,462) [6,111] {3,055}	129,019 (25,804) [6,193] {3,096}
Niagara	16,399	16,490	16,540	16,639	16,772 (3,354) [805] {403}	16,917 (3,383) [812] {406}	17,074 (3,415) [820] {410}
Onondaga	34,127	34,176	34,235	34,328	34,479 (6,896) [1,655] {827}	34,633 (6,927) [1,662] {831}	34,791 (6,958) [1,670] {835}
Orange	42,769	43,015	43,231	43,483	43,977 (8,795) [2,111] {1,055}	44,488 (8,898) [2,135] {1,068}	45,002 (9,000) [2,160] {1,080}
Putnam	9,438	9,468	9,527	9,563	9,662 (1,932) [464] {232}	9,766 (1,953) [469] {234}	9,872 (1,974) [474] {237}
Queens	244,365	245,105	246,197	247,653	250,511 (50,102) [12,025] {6,012}	253,445 (50,689) [12,165] {6,083}	256,393 (51,279) [12,307] {6,153}
Rensselaer	9,931	9,973	10,004	10,053	10,132 (2,026) [486] {243}	10,214 (2,043) [490] {245}	10,298 (2,060) [494] {247}
Richmond	65,304	65,516	65,796	66,184	66,911 (13,382) [3,212] {1,606}	67,650 (13,530) [3,247] {1,624}	68,432 (13,686) [3,285] {1,642}
Rockland	43,237	43,375	43,585	43,718	44,035 (8,807) [2,114] {1,057}	44,349 (8,870) [2,129] {1,064}	44,673 (8,935) [2,144] {1,072}
Saratoga	13,275	13,338	13,389	13,449	13,577 (2,715) [652] {326}	13,708 (2,742) [658] {329}	13,845 (2,769) [665] {332}
Schenectady	11,737	11,775	11,822	11,854	11,942 (2,388) [573] {287}	12,033 (2,407) [578] {289}	12,132 (2,426) [582] {291}
Suffolk	181,006	181,618	182,442	183,206	184,717 (36,943) [8,866] {4,433}	186,245 (37,249) [8,940] {4,470}	187,803 (37,561) [9,015] {4,507}
Sullivan	5,449	5,482	5,535	5,576	5,657 (1,131) [272] {136}	5,745 (1,149) [276] {138}	5,837 (1,167) [280] {140}
Tompkins	3,866	3,878	3,894	3,913	3,952 (790) [190] {95}	3,991 (798) [192] {96}	4,033 (807) [194] {97}
Ulster	11,859	11,918	11,979	12,058	12,226 (2,445) [587] {293}	12,400 (2,480) [595] {298}	12,574 (2,515) [604] {302}
Westchester	118,964	119,242	119,732	120,316	121,274 (24,255) [5,821] {2,911}	122,276 (24,455) [5,869] {2,935}	123,311 (24,662) [5,919] {2,959}

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.