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

Date: 214/22

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 2/14/22 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.

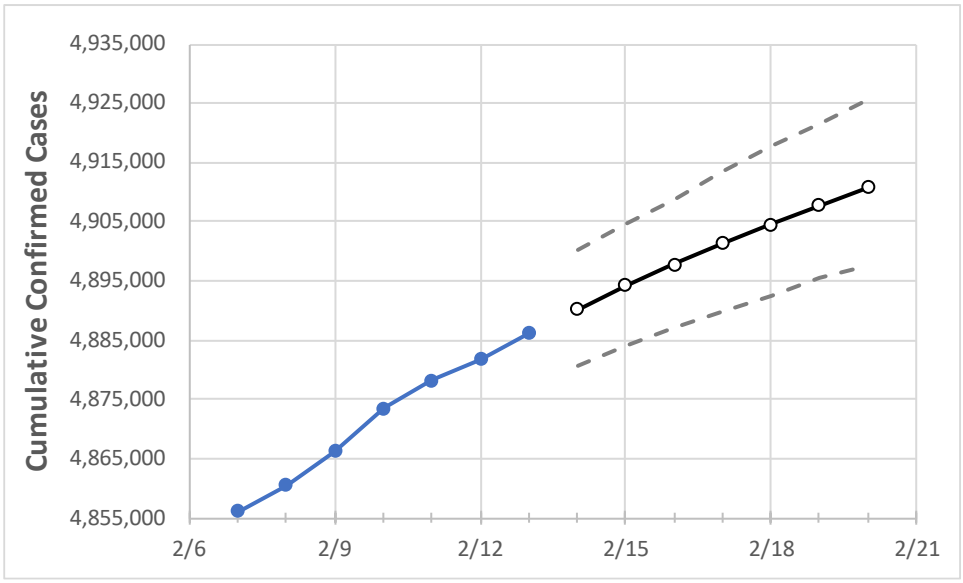
IEM's Modeling Lead

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:						
	2/10	2/11	2/12	2/13	2/14	2/15	2/16	2/17	2/18	2/19	2/20
New York	4,873,548	4,878,304	4,881,825	4,886,180	4,890,220	4,894,253	4,897,851	4,901,440	4,904,567	4,907,840	4,910,870

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:						
	2/10	2/11	2/12	2/13	2/14	2/15	2/16	2/17	2/18	2/19	2/20
Albany	57,086	57,166	57,236	57,292	57,391	57,478	57,563	57,648	57,733	57,819	57,892
Bronx	401,987	402,178	402,385	402,592	402,769	402,931	403,101	403,231	403,386	403,510	403,651
Dutchess	62,548	62,614	62,659	62,716	62,770	62,824	62,871	62,918	62,964	63,009	63,048
Erie	203,336	203,560	203,777	203,945	204,137	204,320	204,489	204,653	204,808	204,956	205,092
Kings	680,029	680,566	681,040	681,514	681,960	682,385	682,790	683,163	683,548	683,863	684,213
Monroe	147,612	147,793	147,942	148,071	148,213	148,347	148,472	148,596	148,708	148,820	148,927
Nassau	395,337	395,623	395,873	396,090	396,327	396,555	396,764	396,974	397,175	397,370	397,545
New York	397,444	397,797	398,161	398,451	398,756	399,061	399,339	399,595	399,842	400,098	400,310
Niagara	46,646	46,692	46,740	46,772	46,814	46,856	46,894	46,932	46,968	47,003	47,034
Onondaga	104,897	105,048	105,247	105,413	105,583	105,744	105,907	106,057	106,206	106,338	106,477
Orange	106,987	106,987	106,987	106,987	107,144	107,295	107,443	107,585	107,725	107,865	107,995
Putnam	23,080	23,097	23,114	23,121	23,134	23,148	23,158	23,170	23,181	23,191	23,201
Queens	630,362	630,730	631,106	631,435	631,808	632,128	632,434	632,727	633,019	633,326	633,553
Rensselaer	30,206	30,250	30,275	30,352	30,401	30,452	30,499	30,543	30,587	30,629	30,669
Richmond	162,877	162,997	163,086	163,175	163,262	163,341	163,416	163,486	163,557	163,622	163,685
Rockland	90,574	90,628	90,674	90,723	90,777	90,830	90,880	90,926	90,969	91,018	91,058
Saratoga	44,224	44,325	44,396	44,437	44,510	44,575	44,638	44,700	44,757	44,817	44,866
Schenectady	31,756	31,837	31,882	31,935	31,981	32,021	32,062	32,100	32,138	32,174	32,206
Suffolk	419,658	419,954	420,205	420,424	420,660	420,880	421,101	421,316	421,494	421,675	421,860
Sullivan	17,923	17,959	17,975	17,992	18,010	18,028	18,044	18,061	18,076	18,091	18,104
Tompkins	16,870	16,910	16,958	17,004	17,038	17,074	17,104	17,138	17,166	17,196	17,226
Ulster	30,276	30,322	30,366	30,396	30,433	30,469	30,503	30,536	30,565	30,597	30,625
Westchester	244,500	244,677	244,862	244,998	245,150	245,291	245,423	245,549	245,678	245,789	245,900

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:		
	2/10	2/11	2/12	2/13	2/15	2/17	2/19
Albany	57,086	57,166	57,236	57,292	57,478 (11,496) [2,759] {1,379}	57,648 (11,530) [2,767] {1,384}	57,819 (11,564) [2,775] {1,388}
Bronx	401,987	402,178	402,385	402,592	402,931 (80,586) [19,341] {9,670}	403,231 (80,646) [19,355] {9,678}	403,510 (80,702) [19,368] {9,684}
Dutchess	62,548	62,614	62,659	62,716	62,824 (12,565) [3,016] {1,508}	62,918 (12,584) [3,020] {1,510}	63,009 (12,602) [3,024] {1,512}
Erie	203,336	203,560	203,777	203,945	204,320 (40,864) [9,807] {4,904}	204,653 (40,931) [9,823] {4,912}	204,956 (40,991) [9,838] {4,919}
Kings	680,029	680,566	681,040	681,514	682,385 (136,477) [32,754] {16,377}	683,163 (136,633) [32,792] {16,396}	683,863 (136,773) [32,825] {16,413}
Monroe	147,612	147,793	147,942	148,071	148,347 (29,669) [7,121] {3,560}	148,596 (29,719) [7,133] {3,566}	148,820 (29,764) [7,143] {3,572}
Nassau	395,337	395,623	395,873	396,090	396,555 (79,311) [19,035] {9,517}	396,974 (79,395) [19,055] {9,527}	397,370 (79,474) [19,074] {9,537}
New York	397,444	397,797	398,161	398,451	399,061 (79,812) [19,155] {9,577}	399,595 (79,919) [19,181] {9,590}	400,098 (80,020) [19,205] {9,602}
Niagara	46,646	46,692	46,740	46,772	46,856 (9,371) [2,249] {1,125}	46,932 (9,386) [2,253] {1,126}	47,003 (9,401) [2,256] {1,128}
Onondaga	104,897	105,048	105,247	105,413	105,744 (21,149) [5,076] {2,538}	106,057 (21,211) [5,091] {2,545}	106,338 (21,268) [5,104] {2,552}
Orange	106,987	106,987	106,987	106,987	107,295 (21,459) [5,150] {2,575}	107,585 (21,517) [5,164] {2,582}	107,865 (21,573) [5,178] {2,589}
Putnam	23,080	23,097	23,114	23,121	23,148 (4,630) [1,111] {556}	23,170 (4,634) [1,112] {556}	23,191 (4,638) [1,113] {557}
Queens	630,362	630,730	631,106	631,435	632,128 (126,426) [30,342] {15,171}	632,727 (126,545) [30,371] {15,185}	633,326 (126,665) [30,400] {15,200}
Rensselaer	30,206	30,250	30,275	30,352	30,452 (6,090) [1,462] {731}	30,543 (6,109) [1,466] {733}	30,629 (6,126) [1,470] {735}
Richmond	162,877	162,997	163,086	163,175	163,341 (32,668) [7,840] {3,920}	163,486 (32,697) [7,847] {3,924}	163,622 (32,724) [7,854] {3,927}
Rockland	90,574	90,628	90,674	90,723	90,830 (18,166) [4,360] {2,180}	90,926 (18,185) [4,364] {2,182}	91,018 (18,204) [4,369] {2,184}
Saratoga	44,224	44,325	44,396	44,437	44,575 (8,915) [2,140] {1,070}	44,700 (8,940) [2,146] {1,073}	44,817 (8,963) [2,151] {1,076}
Schenectady	31,756	31,837	31,882	31,935	32,021 (6,404) [1,537] {768}	32,100 (6,420) [1,541] {770}	32,174 (6,435) [1,544] {772}
Suffolk	419,658	419,954	420,205	420,424	420,880 (84,176) [20,202] {10,101}	421,316 (84,263) [20,223] {10,112}	421,675 (84,335) [20,240] {10,120}
Sullivan	17,923	17,959	17,975	17,992	18,028 (3,606) [865] {433}	18,061 (3,612) [867] {433}	18,091 (3,618) [868] {434}
Tompkins	16,870	16,910	16,958	17,004	17,074 (3,415) [820] {410}	17,138 (3,428) [823] {411}	17,196 (3,439) [825] {413}
Ulster	30,276	30,322	30,366	30,396	30,469 (6,094) [1,463] {731}	30,536 (6,107) [1,466] {733}	30,597 (6,119) [1,469] {734}
Westchester	244,500	244,677	244,862	244,998	245,291 (49,058) [11,774] {5,887}	245,549 (49,110) [11,786] {5,893}	245,789 (49,158) [11,798] {5,899}

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.