IEM's AI Modeling: Short-term COVID-19 Projections
Date: 6/11/21

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 <u>not</u> 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 6/11/21 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
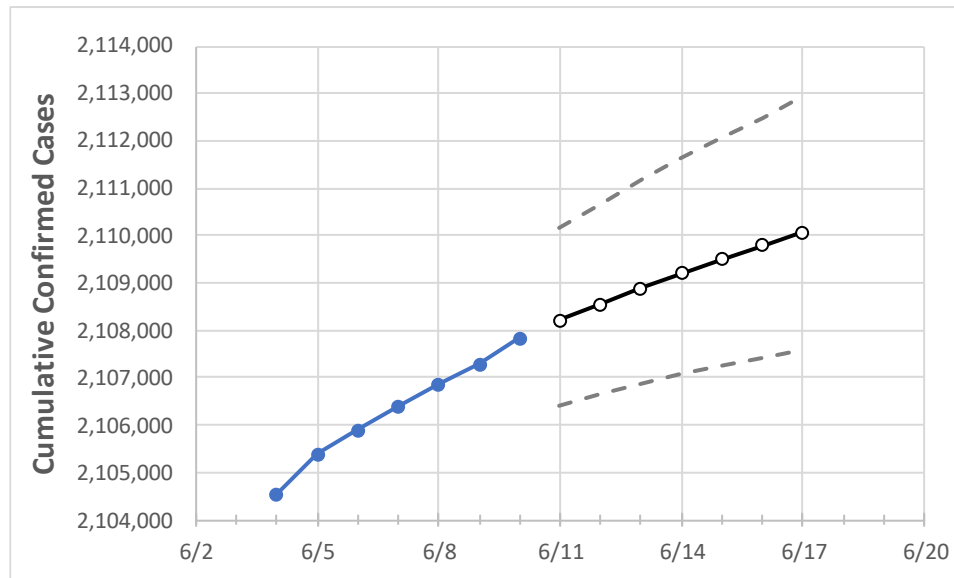
	Actual Confirmed Cases On:				Projected Cases For:						
	6/7	6/8	6/9	6/10	6/11	6/12	6/13	6/14	6/15	6/16	6/17
New York	2,106,399	2,106,852	2,107,289	2,107,831	2,108,203	2,108,555	2,108,891	2,109,213	2,109,509	2,109,789	2,110,069

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:						
	6/7	6/8	6/9	6/10	6/11	6/12	6/13	6/14	6/15	6/16	6/17
Albany	24,675	24,678	24,682	24,685	24,688	24,691	24,694	24,697	24,699	24,701	24,704
Bronx	183,009	183,079	183,131	183,220	183,274	183,328	183,382	183,435	183,486	183,536	183,586
Dutchess	29,448	29,452	29,457	29,460	29,464	29,468	29,472	29,476	29,480	29,483	29,486
Erie	89,472	89,488	89,501	89,520	89,536	89,550	89,564	89,577	89,589	89,601	89,611
Kings	280,110	280,169	280,214	280,306	280,349	280,389	280,426	280,459	280,493	280,524	280,555
Monroe	68,768	68,795	68,821	68,853	68,882	68,909	68,934	68,957	68,979	68,999	69,019
Nassau	183,422	183,449	183,468	183,511	183,532	183,551	183,570	183,589	183,606	183,623	183,639
New York	137,990	138,027	138,060	138,092	138,121	138,147	138,174	138,199	138,224	138,248	138,271
Niagara	20,011	20,015	20,017	20,019	20,022	20,024	20,026	20,028	20,030	20,031	20,033
Onondaga	38,839	38,849	38,859	38,875	38,889	38,903	38,916	38,928	38,940	38,950	38,962
Orange	48,237	48,246	48,257	48,268	48,277	48,285	48,294	48,302	48,309	48,316	48,323
Putnam	10,599	10,600	10,601	10,602	10,604	10,606	10,608	10,610	10,611	10,613	10,615
Queens	276,849	276,909	276,977	277,026	277,073	277,119	277,163	277,204	277,242	277,279	277,313
Rensselaer	11,215	11,217	11,219	11,220	11,222	11,223	11,225	11,226	11,227	11,228	11,230
Richmond	74,822	74,837	74,860	74,877	74,893	74,908	74,923	74,937	74,950	74,963	74,976
Rockland	46,905	46,909	46,915	46,920	46,925	46,930	46,935	46,939	46,943	46,947	46,951
Saratoga	15,342	15,347	15,349	15,350	15,353	15,357	15,360	15,362	15,365	15,367	15,370
Schenectady	13,180	13,182	13,184	13,186	13,189	13,191	13,193	13,195	13,197	13,199	13,200
Suffolk	200,766	200,798	200,824	200,858	200,886	200,913	200,938	200,962	200,985	201,008	201,029
Sullivan	6,661	6,664	6,666	6,668	6,671	6,674	6,676	6,679	6,681	6,683	6,686
Tompkins	4,341	4,343	4,344	4,344	4,346	4,348	4,350	4,351	4,353	4,355	4,356
Ulster	13,889	13,891	13,893	13,894	13,895	13,897	13,898	13,899	13,900	13,901	13,902
Westchester	129,507	129,526	129,552	129,579	129,596	129,612	129,627	129,642	129,656	129,670	129,684

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](link)) 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:		
	6/7	6/8	6/9	6/10	6/12	6/14	6/16
Albany	24,675	24,678	24,682	24,685	24,691 (4,938) [1,185] {593}	24,697 (4,939) [1,185] {593}	24,701 (4,940) [1,186] {593}
Bronx	183,009	183,079	183,131	183,220	183,328 (36,666) [8,800] {4,400}	183,435 (36,687) [8,805] {4,402}	183,536 (36,707) [8,810] {4,405}
Dutchess	29,448	29,452	29,457	29,460	29,468 (5,894) [1,414] {707}	29,476 (5,895) [1,415] {707}	29,483 (5,897) [1,415] {708}
Erie	89,472	89,488	89,501	89,520	89,550 (17,910) [4,298] {2,149}	89,577 (17,915) [4,300] {2,150}	89,601 (17,920) [4,301] {2,150}
Kings	280,110	280,169	280,214	280,306	280,389 (56,078) [13,459] {6,729}	280,459 (56,092) [13,462] {6,731}	280,524 (56,105) [13,465] {6,733}
Monroe	68,768	68,795	68,821	68,853	68,909 (13,782) [3,308] {1,654}	68,957 (13,791) [3,310] {1,655}	68,999 (13,800) [3,312] {1,656}
Nassau	183,422	183,449	183,468	183,511	183,551 (36,710) [8,810] {4,405}	183,589 (36,718) [8,812] {4,406}	183,623 (36,725) [8,814] {4,407}
New York	137,990	138,027	138,060	138,092	138,147 (27,629) [6,631] {3,316}	138,199 (27,640) [6,634] {3,317}	138,248 (27,650) [6,636] {3,318}
Niagara	20,011	20,015	20,017	20,019	20,024 (4,005) [961] {481}	20,028 (4,006) [961] {481}	20,031 (4,006) [961] {481}
Onondaga	38,839	38,849	38,859	38,875	38,903 (7,781) [1,867] {934}	38,928 (7,786) [1,869] {934}	38,950 (7,790) [1,870] {935}
Orange	48,237	48,246	48,257	48,268	48,285 (9,657) [2,318] {1,159}	48,302 (9,660) [2,318] {1,159}	48,316 (9,663) [2,319] {1,160}
Putnam	10,599	10,600	10,601	10,602	10,606 (2,121) [509] {255}	10,610 (2,122) [509] {255}	10,613 (2,123) [509] {255}
Queens	276,849	276,909	276,977	277,026	277,119 (55,424) [13,302] {6,651}	277,204 (55,441) [13,306] {6,653}	277,279 (55,456) [13,309] {6,655}
Rensselaer	11,215	11,217	11,219	11,220	11,223 (2,245) [539] {269}	11,226 (2,245) [539] {269}	11,228 (2,246) [539] {269}
Richmond	74,822	74,837	74,860	74,877	74,908 (14,982) [3,596] {1,798}	74,937 (14,987) [3,597] {1,798}	74,963 (14,993) [3,598] {1,799}
Rockland	46,905	46,909	46,915	46,920	46,930 (9,386) [2,253] {1,126}	46,939 (9,388) [2,253] {1,127}	46,947 (9,389) [2,253] {1,127}
Saratoga	15,342	15,347	15,349	15,350	15,357 (3,071) [737] {369}	15,362 (3,072) [737] {369}	15,367 (3,073) [738] {369}
Schenectady	13,180	13,182	13,184	13,186	13,191 (2,638) [633] {317}	13,195 (2,639) [633] {317}	13,199 (2,640) [634] {317}
Suffolk	200,766	200,798	200,824	200,858	200,913 (40,183) [9,644] {4,822}	200,962 (40,192) [9,646] {4,823}	201,008 (40,202) [9,648] {4,824}
Sullivan	6,661	6,664	6,666	6,668	6,674 (1,335) [320] {160}	6,679 (1,336) [321] {160}	6,683 (1,337) [321] {160}
Tompkins	4,341	4,343	4,344	4,344	4,348 (870) [209] {104}	4,351 (870) [209] {104}	4,355 (871) [209] {105}
Ulster	13,889	13,891	13,893	13,894	13,897 (2,779) [667] {334}	13,899 (2,780) [667] {334}	13,901 (2,780) [667] {334}
Westchester	129,507	129,526	129,552	129,579	129,612 (25,922) [6,221] {3,111}	129,642 (25,928) [6,223] {3,111}	129,670 (25,934) [6,224] {3,112}

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.