IEM's AI Modeling: Short-term COVID-19 Projections
Date: 6/25/21

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 6/25/21 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
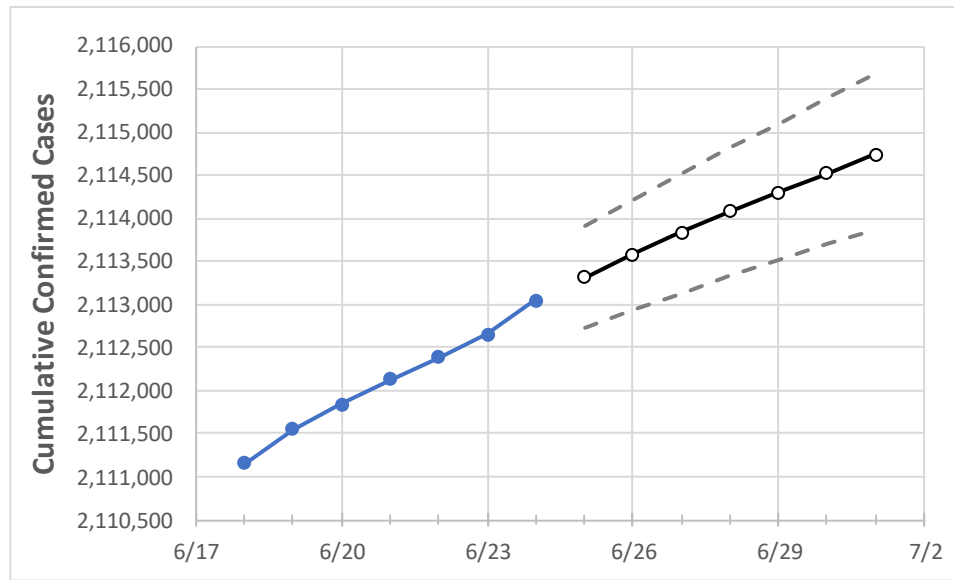
	Actual Confirmed Cases On:				Projected Cases For:						
	6/21	6/22	6/23	6/24	6/25	6/26	6/27	6/28	6/29	6/30	7/1
New York	2,112,129	2,112,388	2,112,649	2,113,046	2,113,317	2,113,584	2,113,834	2,114,079	2,114,305	2,114,527	2,114,742

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:						
	6/21	6/22	6/23	6/24	6/25	6/26	6/27	6/28	6/29	6/30	7/1
Albany	24,718	24,719	24,722	24,723	24,725	24,726	24,728	24,729	24,731	24,732	24,734
Bronx	183,752	183,769	183,787	183,829	183,865	183,899	183,932	183,963	183,994	184,023	184,053
Dutchess	29,488	29,491	29,493	29,494	29,495	29,497	29,498	29,500	29,501	29,502	29,503
Erie	89,614	89,617	89,620	89,626	89,630	89,633	89,636	89,639	89,642	89,644	89,646
Kings	280,905	280,940	280,974	281,040	281,081	281,120	281,159	281,197	281,234	281,271	281,306
Monroe	69,069	69,079	69,090	69,102	69,112	69,121	69,130	69,138	69,146	69,153	69,159
Nassau	183,787	183,809	183,825	183,852	183,872	183,891	183,910	183,928	183,946	183,962	183,979
New York	138,450	138,471	138,498	138,528	138,554	138,579	138,604	138,628	138,652	138,674	138,697
Niagara	20,048	20,050	20,051	20,054	20,055	20,057	20,058	20,059	20,060	20,061	20,062
Onondaga	38,980	38,990	38,998	39,004	39,010	39,016	39,021	39,026	39,031	39,035	39,039
Orange	48,354	48,360	48,365	48,372	48,377	48,383	48,388	48,393	48,398	48,402	48,407
Putnam	10,623	10,623	10,623	10,623	10,624	10,626	10,627	10,629	10,630	10,631	10,633
Queens	277,588	277,620	277,655	277,713	277,751	277,790	277,827	277,864	277,899	277,933	277,965
Rensselaer	11,239	11,241	11,242	11,244	11,245	11,247	11,248	11,249	11,250	11,251	11,252
Richmond	75,112	75,132	75,146	75,183	75,202	75,221	75,240	75,258	75,276	75,294	75,312
Rockland	46,975	46,981	46,986	46,987	46,991	46,995	46,998	47,002	47,006	47,009	47,012
Saratoga	15,393	15,396	15,398	15,399	15,401	15,404	15,406	15,408	15,410	15,413	15,415
Schenectady	13,209	13,210	13,213	13,216	13,217	13,219	13,220	13,221	13,222	13,223	13,224
Suffolk	201,219	201,237	201,261	201,292	201,316	201,339	201,362	201,384	201,406	201,427	201,448
Sullivan	6,683	6,684	6,686	6,686	6,687	6,688	6,689	6,690	6,691	6,692	6,693
Tompkins	4,351	4,352	4,353	4,356	4,357	4,358	4,358	4,359	4,360	4,360	4,361
Ulster	13,917	13,917	13,918	13,921	13,922	13,924	13,925	13,926	13,927	13,928	13,929
Westchester	129,737	129,746	129,757	129,781	129,792	129,803	129,814	129,824	129,835	129,844	129,853

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:		
	6/21	6/22	6/23	6/24	6/26	6/28	6/30
Albany	24,718	24,719	24,722	24,723	24,726 (4,945) [1,187] {593}	24,729 (4,946) [1,187] {594}	24,732 (4,946) [1,187] {594}
Bronx	183,752	183,769	183,787	183,829	183,899 (36,780) [8,827] {4,414}	183,963 (36,793) [8,830] {4,415}	184,023 (36,805) [8,833] {4,417}
Dutchess	29,488	29,491	29,493	29,494	29,497 (5,899) [1,416] {708}	29,500 (5,900) [1,416] {708}	29,502 (5,900) [1,416] {708}
Erie	89,614	89,617	89,620	89,626	89,633 (17,927) [4,302] {2,151}	89,639 (17,928) [4,303] {2,151}	89,644 (17,929) [4,303] {2,151}
Kings	280,905	280,940	280,974	281,040	281,120 (56,224) [13,494] {6,747}	281,197 (56,239) [13,497] {6,749}	281,271 (56,254) [13,501] {6,751}
Monroe	69,069	69,079	69,090	69,102	69,121 (13,824) [3,318] {1,659}	69,138 (13,828) [3,319] {1,659}	69,153 (13,831) [3,319] {1,660}
Nassau	183,787	183,809	183,825	183,852	183,891 (36,778) [8,827] {4,413}	183,928 (36,786) [8,829] {4,414}	183,962 (36,792) [8,830] {4,415}
New York	138,450	138,471	138,498	138,528	138,579 (27,716) [6,652] {3,326}	138,628 (27,726) [6,654] {3,327}	138,674 (27,735) [6,656] {3,328}
Niagara	20,048	20,050	20,051	20,054	20,057 (4,011) [963] {481}	20,059 (4,012) [963] {481}	20,061 (4,012) [963] {481}
Onondaga	38,980	38,990	38,998	39,004	39,016 (7,803) [1,873] {936}	39,026 (7,805) [1,873] {937}	39,035 (7,807) [1,874] {937}
Orange	48,354	48,360	48,365	48,372	48,383 (9,677) [2,322] {1,161}	48,393 (9,679) [2,323] {1,161}	48,402 (9,680) [2,323] {1,162}
Putnam	10,623	10,623	10,623	10,623	10,626 (2,125) [510] {255}	10,629 (2,126) [510] {255}	10,631 (2,126) [510] {255}
Queens	277,588	277,620	277,655	277,713	277,790 (55,558) [13,334] {6,667}	277,864 (55,573) [13,337] {6,669}	277,933 (55,587) [13,341] {6,670}
Rensselaer	11,239	11,241	11,242	11,244	11,247 (2,249) [540] {270}	11,249 (2,250) [540] {270}	11,251 (2,250) [540] {270}
Richmond	75,112	75,132	75,146	75,183	75,221 (15,044) [3,611] {1,805}	75,258 (15,052) [3,612] {1,806}	75,294 (15,059) [3,614] {1,807}
Rockland	46,975	46,981	46,986	46,987	46,995 (9,399) [2,256] {1,128}	47,002 (9,400) [2,256] {1,128}	47,009 (9,402) [2,256] {1,128}
Saratoga	15,393	15,396	15,398	15,399	15,404 (3,081) [739] {370}	15,408 (3,082) [740] {370}	15,413 (3,083) [740] {370}
Schenectady	13,209	13,210	13,213	13,216	13,219 (2,644) [634] {317}	13,221 (2,644) [635] {317}	13,223 (2,645) [635] {317}
Suffolk	201,219	201,237	201,261	201,292	201,339 (40,268) [9,664] {4,832}	201,384 (40,277) [9,666] {4,833}	201,427 (40,285) [9,669] {4,834}
Sullivan	6,683	6,684	6,686	6,686	6,688 (1,338) [321] {161}	6,690 (1,338) [321] {161}	6,692 (1,338) [321] {161}
Tompkins	4,351	4,352	4,353	4,356	4,358 (872) [209] {105}	4,359 (872) [209] {105}	4,360 (872) [209] {105}
Ulster	13,917	13,917	13,918	13,921	13,924 (2,785) [668] {334}	13,926 (2,785) [668] {334}	13,928 (2,786) [669] {334}
Westchester	129,737	129,746	129,757	129,781	129,803 (25,961) [6,231] {3,115}	129,824 (25,965) [6,232] {3,116}	129,844 (25,969) [6,233] {3,116}

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.