IEM's AI Modeling: Short-term COVID-19 Projections
Date: 11/10/21

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 11/10/21 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
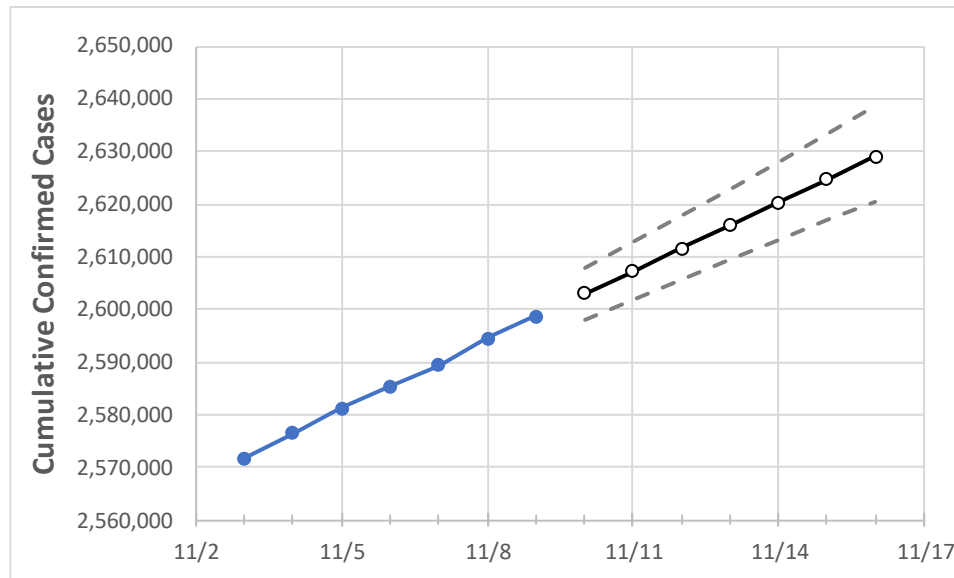
	Actual Confirmed Cases On:				Projected Cases For:						
	11/6	11/7	11/8	11/9	11/10	11/11	11/12	11/13	11/14	11/15	11/16
New York	2,585,365	2,589,297	2,594,515	2,598,730	2,602,988	2,607,265	2,611,623	2,616,016	2,620,293	2,624,766	2,629,134

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:						
	11/6	11/7	11/8	11/9	11/10	11/11	11/12	11/13	11/14	11/15	11/16
Albany	32,078	32,146	32,205	32,292	32,367	32,444	32,519	32,594	32,668	32,744	32,818
Bronx	209,545	209,665	209,784	209,924	210,037	210,151	210,261	210,372	210,484	210,591	210,704
Dutchess	36,352	36,401	36,432	36,492	36,537	36,583	36,629	36,673	36,717	36,760	36,804
Erie	111,452	111,900	112,244	112,610	113,027	113,439	113,856	114,286	114,719	115,175	115,636
Kings	339,536	339,902	340,269	340,605	340,949	341,289	341,630	341,971	342,313	342,652	342,988
Monroe	88,122	88,521	88,777	89,030	89,336	89,643	89,954	90,270	90,596	90,930	91,262
Nassau	217,518	217,726	217,879	218,094	218,297	218,502	218,705	218,913	219,119	219,326	219,531
New York	170,642	170,859	171,016	171,173	171,347	171,513	171,684	171,857	172,030	172,205	172,372
Niagara	25,267	25,360	25,436	25,542	25,637	25,731	25,831	25,931	26,034	26,139	26,243
Onondaga	54,627	54,811	54,953	55,074	55,233	55,392	55,549	55,708	55,867	56,026	56,182
Orange	58,903	59,000	59,075	59,162	59,250	59,340	59,431	59,518	59,609	59,700	59,791
Putnam	12,707	12,716	12,726	12,734	12,744	12,755	12,764	12,774	12,784	12,793	12,802
Queens	318,571	318,813	319,055	319,313	319,541	319,783	320,022	320,264	320,502	320,751	320,994
Rensselaer	15,630	15,702	15,757	15,809	15,869	15,927	15,988	16,048	16,109	16,172	16,237
Richmond	90,193	90,254	90,316	90,380	90,442	90,503	90,564	90,623	90,682	90,740	90,798
Rockland	54,014	54,049	54,068	54,130	54,179	54,229	54,276	54,325	54,373	54,420	54,467
Saratoga	21,455	21,555	21,624	21,697	21,782	21,866	21,950	22,039	22,124	22,214	22,300
Schenectady	17,590	17,657	17,712	17,756	17,809	17,861	17,914	17,964	18,017	18,071	18,124
Suffolk	244,021	244,348	244,622	244,879	245,151	245,431	245,703	245,979	246,252	246,522	246,799
Sullivan	8,781	8,802	8,820	8,833	8,852	8,870	8,888	8,906	8,924	8,943	8,961
Tompkins	6,768	6,798	6,806	6,824	6,842	6,859	6,876	6,894	6,911	6,929	6,947
Ulster	17,728	17,760	17,785	17,809	17,840	17,869	17,900	17,930	17,961	17,992	18,022
Westchester	144,859	144,943	145,017	145,098	145,177	145,256	145,335	145,416	145,497	145,578	145,657

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:		
	11/6	11/7	11/8	11/9	11/11	11/13	11/15
Albany	32,078	32,146	32,205	32,292	32,444 (6,489) [1,557] {779}	32,594 (6,519) [1,565] {782}	32,744 (6,549) [1,572] {786}
Bronx	209,545	209,665	209,784	209,924	210,151 (42,030) [10,087] {5,044}	210,372 (42,074) [10,098] {5,049}	210,591 (42,118) [10,108] {5,054}
Dutchess	36,352	36,401	36,432	36,492	36,583 (7,317) [1,756] {878}	36,673 (7,335) [1,760] {880}	36,760 (7,352) [1,764] {882}
Erie	111,452	111,900	112,244	112,610	113,439 (22,688) [5,445] {2,723}	114,286 (22,857) [5,486] {2,743}	115,175 (23,035) [5,528] {2,764}
Kings	339,536	339,902	340,269	340,605	341,289 (68,258) [16,382] {8,191}	341,971 (68,394) [16,415] {8,207}	342,652 (68,530) [16,447] {8,224}
Monroe	88,122	88,521	88,777	89,030	89,643 (17,929) [4,303] {2,151}	90,270 (18,054) [4,333] {2,166}	90,930 (18,186) [4,365] {2,182}
Nassau	217,518	217,726	217,879	218,094	218,502 (43,700) [10,488] {5,244}	218,913 (43,783) [10,508] {5,254}	219,326 (43,865) [10,528] {5,264}
New York	170,642	170,859	171,016	171,173	171,513 (34,303) [8,233] {4,116}	171,857 (34,371) [8,249] {4,125}	172,205 (34,441) [8,266] {4,133}
Niagara	25,267	25,360	25,436	25,542	25,731 (5,146) [1,235] {618}	25,931 (5,186) [1,245] {622}	26,139 (5,228) [1,255] {627}
Onondaga	54,627	54,811	54,953	55,074	55,392 (11,078) [2,659] {1,329}	55,708 (11,142) [2,674] {1,337}	56,026 (11,205) [2,689] {1,345}
Orange	58,903	59,000	59,075	59,162	59,340 (11,868) [2,848] {1,424}	59,518 (11,904) [2,857] {1,428}	59,700 (11,940) [2,866] {1,433}
Putnam	12,707	12,716	12,726	12,734	12,755 (2,551) [612] {306}	12,774 (2,555) [613] {307}	12,793 (2,559) [614] {307}
Queens	318,571	318,813	319,055	319,313	319,783 (63,957) [15,350] {7,675}	320,264 (64,053) [15,373] {7,686}	320,751 (64,150) [15,396] {7,698}
Rensselaer	15,630	15,702	15,757	15,809	15,927 (3,185) [765] {382}	16,048 (3,210) [770] {385}	16,172 (3,234) [776] {388}
Richmond	90,193	90,254	90,316	90,380	90,503 (18,101) [4,344] {2,172}	90,623 (18,125) [4,350] {2,175}	90,740 (18,148) [4,356] {2,178}
Rockland	54,014	54,049	54,068	54,130	54,229 (10,846) [2,603] {1,302}	54,325 (10,865) [2,608] {1,304}	54,420 (10,884) [2,612] {1,306}
Saratoga	21,455	21,555	21,624	21,697	21,866 (4,373) [1,050] {525}	22,039 (4,408) [1,058] {529}	22,214 (4,443) [1,066] {533}
Schenectady	17,590	17,657	17,712	17,756	17,861 (3,572) [857] {429}	17,964 (3,593) [862] {431}	18,071 (3,614) [867] {434}
Suffolk	244,021	244,348	244,622	244,879	245,431 (49,086) [11,781] {5,890}	245,979 (49,196) [11,807] {5,903}	246,522 (49,304) [11,833] {5,917}
Sullivan	8,781	8,802	8,820	8,833	8,870 (1,774) [426] {213}	8,906 (1,781) [427] {214}	8,943 (1,789) [429] {215}
Tompkins	6,768	6,798	6,806	6,824	6,859 (1,372) [329] {165}	6,894 (1,379) [331] {165}	6,929 (1,386) [333] {166}
Ulster	17,728	17,760	17,785	17,809	17,869 (3,574) [858] {429}	17,930 (3,586) [861] {430}	17,992 (3,598) [864] {432}
Westchester	144,859	144,943	145,017	145,098	145,256 (29,051) [6,972] {3,486}	145,416 (29,083) [6,980] {3,490}	145,578 (29,116) [6,988] {3,494}

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.