IEM's AI Modeling: Short-term COVID-19 Projections
Date: 9/14/20

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 20%, and are often within 10%, of actual confirmed cases.

The projections shown in this document are based on data pulled in as of 9/14/20 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
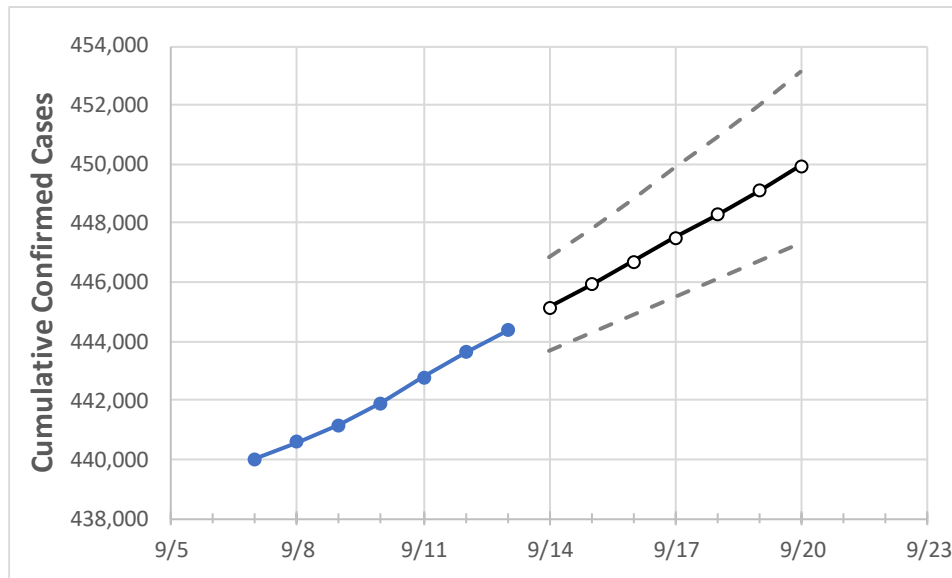
	Actual Confirmed Cases On:				Projected Cases For:						
	9/10	9/11	9/12	9/13	9/14	9/15	9/16	9/17	9/18	9/19	9/20
New York	441,911	442,791	443,640	444,365	445,137	445,916	446,703	447,498	448,300	449,110	449,927

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 20%, and are often within 10%, of actual confirmed cases.

New York Counties

	Actual Confirmed Cases On:				Projected Cases For:						
	9/10	9/11	9/12	9/13	9/14	9/15	9/16	9/17	9/18	9/19	9/20
Albany	2,859	2,882	2,896	2,915	2,925	2,935	2,945	2,956	2,967	2,978	2,989
Bronx	52,076	52,125	52,186	52,235	52,280	52,324	52,368	52,412	52,455	52,498	52,540
Dutchess	4,962	4,975	4,984	4,986	4,993	4,999	5,006	5,012	5,018	5,024	5,030
Erie	10,444	10,503	10,567	10,637	10,692	10,747	10,802	10,856	10,911	10,965	11,019
Kings	65,929	66,009	66,124	66,197	66,289	66,382	66,475	66,569	66,664	66,759	66,855
Monroe	5,648	5,676	5,712	5,727	5,747	5,767	5,787	5,808	5,829	5,850	5,872
Nassau	45,445	45,550	45,633	45,711	45,802	45,895	45,991	46,089	46,190	46,294	46,400
New York	32,551	32,603	32,643	32,677	32,712	32,747	32,782	32,816	32,849	32,883	32,915
Niagara	1,666	1,671	1,678	1,685	1,690	1,695	1,700	1,705	1,711	1,716	1,721
Onondaga	4,023	4,043	4,060	4,081	4,095	4,110	4,124	4,139	4,154	4,169	4,184
Orange	11,572	11,594	11,611	11,635	11,652	11,670	11,689	11,707	11,727	11,746	11,767
Putnam	1,546	1,550	1,554	1,557	1,562	1,566	1,571	1,576	1,581	1,587	1,592
Queens	70,917	70,978	71,040	71,111	71,177	71,243	71,309	71,375	71,441	71,508	71,574
Rensselaer	867	870	876	879	881	884	886	888	891	893	895
Richmond	15,510	15,537	15,565	15,582	15,608	15,634	15,661	15,689	15,717	15,747	15,776
Rockland	14,480	14,510	14,530	14,547	14,572	14,599	14,625	14,653	14,681	14,709	14,739
Saratoga	918	943	955	961	973	985	999	1,013	1,029	1,045	1,063
Schenectady	1,335	1,343	1,351	1,356	1,361	1,366	1,371	1,376	1,381	1,386	1,391
Suffolk	45,463	45,534	45,615	45,683	45,760	45,840	45,921	46,005	46,091	46,180	46,271
Sullivan	1,548	1,549	1,549	1,553	1,554	1,556	1,557	1,558	1,559	1,561	1,562
Tompkins	361	369	375	381	393	407	422	439	458	479	503
Ulster	2,204	2,209	2,215	2,218	2,219	2,221	2,222	2,224	2,225	2,226	2,227
Westchester	37,405	37,454	37,486	37,531	37,576	37,622	37,668	37,714	37,761	37,809	37,857

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:		
	9/10	9/11	9/12	9/13	9/15	9/17	9/19
Albany	2,859	2,882	2,896	2,915	2,935 (587) [141] {70}	2,956 (591) [142] {71}	2,978 (596) [143] {71}
Bronx	52,076	52,125	52,186	52,235	52,324 (10,465) [2,512] {1,256}	52,412 (10,482) [2,516] {1,258}	52,498 (10,500) [2,520] {1,260}
Dutchess	4,962	4,975	4,984	4,986	4,999 (1,000) [240] {120}	5,012 (1,002) [241] {120}	5,024 (1,005) [241] {121}
Erie	10,444	10,503	10,567	10,637	10,747 (2,149) [516] {258}	10,856 (2,171) [521] {261}	10,965 (2,193) [526] {263}
Kings	65,929	66,009	66,124	66,197	66,382 (13,276) [3,186] {1,593}	66,569 (13,314) [3,195] {1,598}	66,759 (13,352) [3,204] {1,602}
Monroe	5,648	5,676	5,712	5,727	5,767 (1,153) [277] {138}	5,808 (1,162) [279] {139}	5,850 (1,170) [281] {140}
Nassau	45,445	45,550	45,633	45,711	45,895 (9,179) [2,203] {1,101}	46,089 (9,218) [2,212] {1,106}	46,294 (9,259) [2,222] {1,111}
New York	32,551	32,603	32,643	32,677	32,747 (6,549) [1,572] {786}	32,816 (6,563) [1,575] {788}	32,883 (6,577) [1,578] {789}
Niagara	1,666	1,671	1,678	1,685	1,695 (339) [81] {41}	1,705 (341) [82] {41}	1,716 (343) [82] {41}
Onondaga	4,023	4,043	4,060	4,081	4,110 (822) [197] {99}	4,139 (828) [199] {99}	4,169 (834) [200] {100}
Orange	11,572	11,594	11,611	11,635	11,670 (2,334) [560] {280}	11,707 (2,341) [562] {281}	11,746 (2,349) [564] {282}
Putnam	1,546	1,550	1,554	1,557	1,566 (313) [75] {38}	1,576 (315) [76] {38}	1,587 (317) [76] {38}
Queens	70,917	70,978	71,040	71,111	71,243 (14,249) [3,420] {1,710}	71,375 (14,275) [3,426] {1,713}	71,508 (14,302) [3,432] {1,716}
Rensselaer	867	870	876	879	884 (177) [42] {21}	888 (178) [43] {21}	893 (179) [43] {21}
Richmond	15,510	15,537	15,565	15,582	15,634 (3,127) [750] {375}	15,689 (3,138) [753] {377}	15,747 (3,149) [756] {378}
Rockland	14,480	14,510	14,530	14,547	14,599 (2,920) [701] {350}	14,653 (2,931) [703] {352}	14,709 (2,942) [706] {353}
Saratoga	918	943	955	961	985 (197) [47] {24}	1,013 (203) [49] {24}	1,045 (209) [50] {25}
Schenectady	1,335	1,343	1,351	1,356	1,366 (273) [66] {33}	1,376 (275) [66] {33}	1,386 (277) [67] {33}
Suffolk	45,463	45,534	45,615	45,683	45,840 (9,168) [2,200] {1,100}	46,005 (9,201) [2,208] {1,104}	46,180 (9,236) [2,217] {1,108}
Sullivan	1,548	1,549	1,549	1,553	1,556 (311) [75] {37}	1,558 (312) [75] {37}	1,561 (312) [75] {37}
Tompkins	361	369	375	381	407 (81) [20] {10}	439 (88) [21] {11}	479 (96) [23] {11}
Ulster	2,204	2,209	2,215	2,218	2,221 (444) [107] {53}	2,224 (445) [107] {53}	2,226 (445) [107] {53}
Westchester	37,405	37,454	37,486	37,531	37,622 (7,524) [1,806] {903}	37,714 (7,543) [1,810] {905}	37,809 (7,562) [1,815] {907}

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.