IEM's AI Modeling: Short-term COVID-19 Projections
Date: 9/11/20

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 9/11/20 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
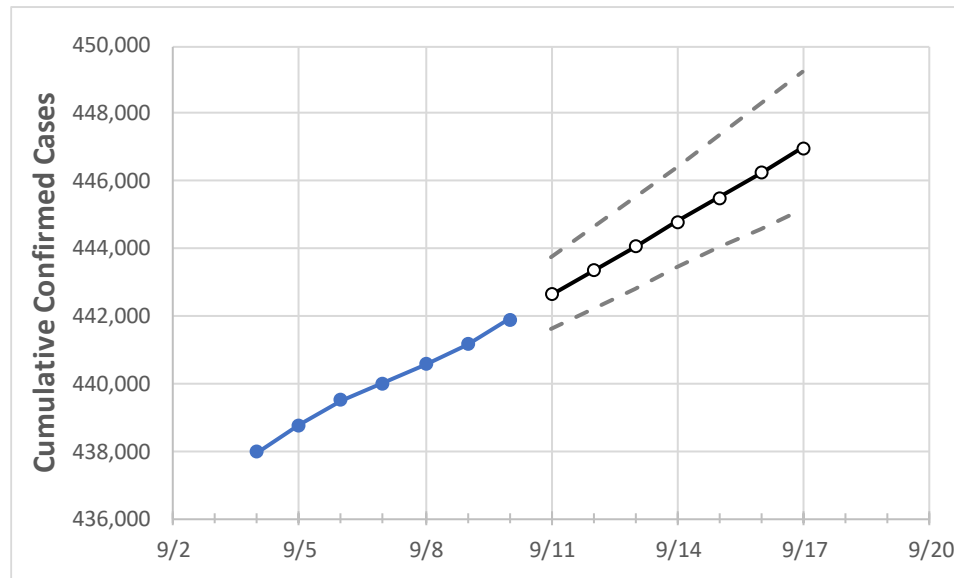
	Actual Confirmed Cases On:				Projected Cases For:						
	9/7	9/8	9/9	9/10	9/11	9/12	9/13	9/14	9/15	9/16	9/17
New York	440,021	440,578	441,154	441,911	442,626	443,343	444,062	444,784	445,509	446,237	446,968

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:						
	9/7	9/8	9/9	9/10	9/11	9/12	9/13	9/14	9/15	9/16	9/17
Albany	2,833	2,840	2,846	2,859	2,865	2,872	2,878	2,884	2,890	2,896	2,902
Bronx	51,944	51,984	52,018	52,076	52,121	52,164	52,207	52,250	52,291	52,332	52,373
Dutchess	4,939	4,944	4,956	4,962	4,970	4,978	4,987	4,995	5,003	5,010	5,018
Erie	10,320	10,346	10,394	10,444	10,504	10,565	10,627	10,690	10,753	10,818	10,884
Kings	65,700	65,757	65,819	65,929	66,022	66,115	66,209	66,304	66,400	66,497	66,595
Monroe	5,585	5,602	5,615	5,648	5,665	5,682	5,699	5,716	5,733	5,750	5,767
Nassau	45,229	45,294	45,372	45,445	45,526	45,610	45,695	45,783	45,872	45,964	46,058
New York	32,442	32,461	32,500	32,551	32,586	32,621	32,655	32,689	32,722	32,755	32,787
Niagara	1,654	1,659	1,663	1,666	1,670	1,675	1,679	1,683	1,687	1,692	1,696
Onondaga	3,993	4,002	4,012	4,023	4,035	4,046	4,058	4,069	4,080	4,091	4,102
Orange	11,525	11,535	11,552	11,572	11,586	11,601	11,615	11,630	11,645	11,660	11,676
Putnam	1,534	1,539	1,541	1,541	1,545	1,549	1,553	1,557	1,562	1,566	1,571
Queens	70,675	70,766	70,824	70,917	70,986	71,055	71,124	71,193	71,263	71,333	71,403
Rensselaer	860	865	866	867	869	871	873	874	876	878	879
Richmond	15,451	15,466	15,486	15,510	15,535	15,561	15,587	15,615	15,643	15,672	15,702
Rockland	14,418	14,439	14,459	14,480	14,505	14,531	14,558	14,586	14,615	14,644	14,674
Saratoga	893	900	911	918	927	936	947	958	969	982	995
Schenectady	1,314	1,322	1,324	1,335	1,340	1,344	1,349	1,353	1,357	1,362	1,366
Suffolk	45,304	45,356	45,411	45,463	45,531	45,602	45,673	45,747	45,823	45,901	45,980
Sullivan	1,544	1,545	1,547	1,548	1,550	1,551	1,553	1,554	1,556	1,557	1,559
Tompkins	339	344	346	361	373	387	403	421	442	466	493
Ulster	2,203	2,203	2,204	2,204	2,205	2,207	2,208	2,209	2,210	2,211	2,212
Westchester	37,277	37,314	37,355	37,405	37,450	37,496	37,543	37,590	37,638	37,687	37,736

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:		
	9/7	9/8	9/9	9/10	9/12	9/14	9/16
Albany	2,833	2,840	2,846	2,859	2,872 (574) [138] {69}	2,884 (577) [138] {69}	2,896 (579) [139] {70}
Bronx	51,944	51,984	52,018	52,076	52,164 (10,433) [2,504] {1,252}	52,250 (10,450) [2,508] {1,254}	52,332 (10,466) [2,512] {1,256}
Dutchess	4,939	4,944	4,956	4,962	4,978 (996) [239] {119}	4,995 (999) [240] {120}	5,010 (1,002) [241] {120}
Erie	10,320	10,346	10,394	10,444	10,565 (2,113) [507] {254}	10,690 (2,138) [513] {257}	10,818 (2,164) [519] {260}
Kings	65,700	65,757	65,819	65,929	66,115 (13,223) [3,174] {1,587}	66,304 (13,261) [3,183] {1,591}	66,497 (13,299) [3,192] {1,596}
Monroe	5,585	5,602	5,615	5,648	5,682 (1,136) [273] {136}	5,716 (1,143) [274] {137}	5,750 (1,150) [276] {138}
Nassau	45,229	45,294	45,372	45,445	45,610 (9,122) [2,189] {1,095}	45,783 (9,157) [2,198] {1,099}	45,964 (9,193) [2,206] {1,103}
New York	32,442	32,461	32,500	32,551	32,621 (6,524) [1,566] {783}	32,689 (6,538) [1,569] {785}	32,755 (6,551) [1,572] {786}
Niagara	1,654	1,659	1,663	1,666	1,675 (335) [80] {40}	1,683 (337) [81] {40}	1,692 (338) [81] {41}
Onondaga	3,993	4,002	4,012	4,023	4,046 (809) [194] {97}	4,069 (814) [195] {98}	4,091 (818) [196] {98}
Orange	11,525	11,535	11,552	11,572	11,601 (2,320) [557] {278}	11,630 (2,326) [558] {279}	11,660 (2,332) [560] {280}
Putnam	1,534	1,539	1,541	1,541	1,549 (310) [74] {37}	1,557 (311) [75] {37}	1,566 (313) [75] {38}
Queens	70,675	70,766	70,824	70,917	71,055 (14,211) [3,411] {1,705}	71,193 (14,239) [3,417] {1,709}	71,333 (14,267) [3,424] {1,712}
Rensselaer	860	865	866	867	871 (174) [42] {21}	874 (175) [42] {21}	878 (176) [42] {21}
Richmond	15,451	15,466	15,486	15,510	15,561 (3,112) [747] {373}	15,615 (3,123) [750] {375}	15,672 (3,134) [752] {376}
Rockland	14,418	14,439	14,459	14,480	14,531 (2,906) [698] {349}	14,586 (2,917) [700] {350}	14,644 (2,929) [703] {351}
Saratoga	893	900	911	918	936 (187) [45] {22}	958 (192) [46] {23}	982 (196) [47] {24}
Schenectady	1,314	1,322	1,324	1,335	1,344 (269) [65] {32}	1,353 (271) [65] {32}	1,362 (272) [65] {33}
Suffolk	45,304	45,356	45,411	45,463	45,602 (9,120) [2,189] {1,094}	45,747 (9,149) [2,196] {1,098}	45,901 (9,180) [2,203] {1,102}
Sullivan	1,544	1,545	1,547	1,548	1,551 (310) [74] {37}	1,554 (311) [75] {37}	1,557 (311) [75] {37}
Tompkins	339	344	346	361	387 (77) [19] {9}	421 (84) [20] {10}	466 (93) [22] {11}
Ulster	2,203	2,203	2,204	2,204	2,207 (441) [106] {53}	2,209 (442) [106] {53}	2,211 (442) [106] {53}
Westchester	37,277	37,314	37,355	37,405	37,496 (7,499) [1,800] {900}	37,590 (7,518) [1,804] {902}	37,687 (7,537) [1,809] {904}

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.