IEM's AI Modeling: Short-term COVID-19 Projections
Date: 2/5/21

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 2/5/21 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
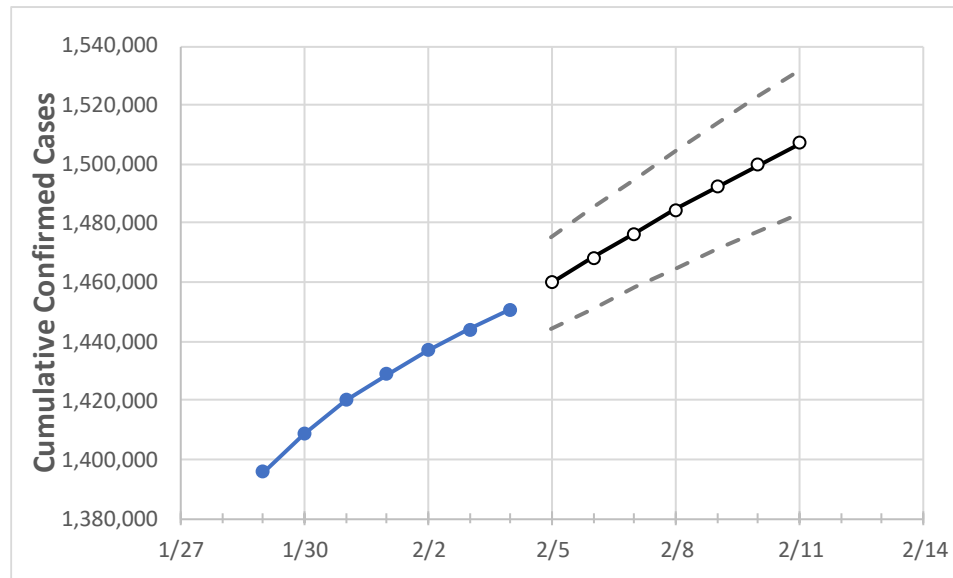
	Actual Confirmed Cases On:				Projected Cases For:						
	2/1	2/2	2/3	2/4	2/5	2/6	2/7	2/8	2/9	2/10	2/11
New York	1,428,839	1,436,788	1,443,942	1,450,912	1,459,776	1,468,348	1,476,580	1,484,679	1,492,260	1,499,792	1,507,040

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:						
	2/1	2/2	2/3	2/4	2/5	2/6	2/7	2/8	2/9	2/10	2/11
Albany	18,771	18,858	18,938	19,100	19,229	19,357	19,478	19,596	19,712	19,824	19,929
Bronx	120,674	121,465	122,235	122,727	123,653	124,542	125,423	126,286	127,123	127,942	128,748
Dutchess	19,296	19,408	19,442	19,512	19,641	19,769	19,888	20,006	20,119	20,233	20,337
Erie	57,642	57,858	58,099	58,612	58,942	59,266	59,585	59,897	60,203	60,508	60,788
Kings	176,617	177,798	178,939	179,741	181,104	182,434	183,740	185,046	186,316	187,578	188,804
Monroe	48,163	48,304	48,534	48,781	48,974	49,166	49,347	49,526	49,688	49,854	50,008
Nassau	129,654	130,386	130,933	131,544	132,362	133,128	133,872	134,606	135,314	135,977	136,635
New York	86,431	86,953	87,468	87,851	88,499	89,137	89,775	90,391	90,993	91,587	92,179
Niagara	13,752	13,796	13,886	14,016	14,108	14,196	14,284	14,367	14,449	14,528	14,602
Onondaga	30,124	30,232	30,350	30,421	30,530	30,634	30,728	30,823	30,910	30,995	31,076
Orange	32,407	32,580	32,664	32,830	33,028	33,225	33,413	33,595	33,779	33,954	34,123
Putnam	7,384	7,423	7,432	7,456	7,497	7,537	7,575	7,613	7,649	7,682	7,716
Queens	179,401	180,602	181,723	182,409	183,666	184,876	186,049	187,200	188,319	189,401	190,459
Rensselaer	8,006	8,035	8,064	8,133	8,186	8,237	8,287	8,333	8,380	8,423	8,464
Richmond	50,025	50,255	50,515	50,646	50,891	51,130	51,360	51,581	51,789	51,993	52,184
Rockland	34,704	34,830	34,950	35,094	35,256	35,412	35,565	35,713	35,864	36,006	36,144
Saratoga	10,604	10,657	10,718	10,795	10,853	10,907	10,958	11,005	11,049	11,092	11,132
Schenectady	9,798	9,836	9,881	9,953	10,009	10,062	10,111	10,161	10,207	10,252	10,294
Suffolk	144,337	145,115	145,642	146,293	147,046	147,772	148,466	149,124	149,748	150,333	150,901
Sullivan	4,221	4,250	4,258	4,278	4,298	4,318	4,338	4,357	4,375	4,391	4,408
Tompkins	3,015	3,044	3,057	3,100	3,125	3,149	3,174	3,199	3,223	3,248	3,273
Ulster	8,858	8,899	8,909	8,955	9,015	9,075	9,132	9,188	9,243	9,294	9,345
Westchester	94,698	95,303	95,642	95,989	96,552	97,094	97,613	98,119	98,611	99,101	99,577

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:		
	2/1	2/2	2/3	2/4	2/6	2/8	2/10
Albany	18,771	18,858	18,938	19,100	19,357 (3,871) [929] {465}	19,596 (3,919) [941] {470}	19,824 (3,965) [952] {476}
Bronx	120,674	121,465	122,235	122,727	124,542 (24,908) [5,978] {2,989}	126,286 (25,257) [6,062] {3,031}	127,942 (25,588) [6,141] {3,071}
Dutchess	19,296	19,408	19,442	19,512	19,769 (3,954) [949] {474}	20,006 (4,001) [960] {480}	20,233 (4,047) [971] {486}
Erie	57,642	57,858	58,099	58,612	59,266 (11,853) [2,845] {1,422}	59,897 (11,979) [2,875] {1,438}	60,508 (12,102) [2,904] {1,452}
Kings	176,617	177,798	178,939	179,741	182,434 (36,487) [8,757] {4,378}	185,046 (37,009) [8,882] {4,441}	187,578 (37,516) [9,004] {4,502}
Monroe	48,163	48,304	48,534	48,781	49,166 (9,833) [2,360] {1,180}	49,526 (9,905) [2,377] {1,189}	49,854 (9,971) [2,393] {1,196}
Nassau	129,654	130,386	130,933	131,544	133,128 (26,626) [6,390] {3,195}	134,606 (26,921) [6,461] {3,231}	135,977 (27,195) [6,527] {3,263}
New York	86,431	86,953	87,468	87,851	89,137 (17,827) [4,279] {2,139}	90,391 (18,078) [4,339] {2,169}	91,587 (18,317) [4,396] {2,198}
Niagara	13,752	13,796	13,886	14,016	14,196 (2,839) [681] {341}	14,367 (2,873) [690] {345}	14,528 (2,906) [697] {349}
Onondaga	30,124	30,232	30,350	30,421	30,634 (6,127) [1,470] {735}	30,823 (6,165) [1,479] {740}	30,995 (6,199) [1,488] {744}
Orange	32,407	32,580	32,664	32,830	33,225 (6,645) [1,595] {797}	33,595 (6,719) [1,613] {806}	33,954 (6,791) [1,630] {815}
Putnam	7,384	7,423	7,432	7,456	7,537 (1,507) [362] {181}	7,613 (1,523) [365] {183}	7,682 (1,536) [369] {184}
Queens	179,401	180,602	181,723	182,409	184,876 (36,975) [8,874] {4,437}	187,200 (37,440) [8,986] {4,493}	189,401 (37,880) [9,091] {4,546}
Rensselaer	8,006	8,035	8,064	8,133	8,237 (1,647) [395] {198}	8,333 (1,667) [400] {200}	8,423 (1,685) [404] {202}
Richmond	50,025	50,255	50,515	50,646	51,130 (10,226) [2,454] {1,227}	51,581 (10,316) [2,476] {1,238}	51,993 (10,399) [2,496] {1,248}
Rockland	34,704	34,830	34,950	35,094	35,412 (7,082) [1,700] {850}	35,713 (7,143) [1,714] {857}	36,006 (7,201) [1,728] {864}
Saratoga	10,604	10,657	10,718	10,795	10,907 (2,181) [524] {262}	11,005 (2,201) [528] {264}	11,092 (2,218) [532] {266}
Schenectady	9,798	9,836	9,881	9,953	10,062 (2,012) [483] {241}	10,161 (2,032) [488] {244}	10,252 (2,050) [492] {246}
Suffolk	144,337	145,115	145,642	146,293	147,772 (29,554) [7,093] {3,547}	149,124 (29,825) [7,158] {3,579}	150,333 (30,067) [7,216] {3,608}
Sullivan	4,221	4,250	4,258	4,278	4,318 (864) [207] {104}	4,357 (871) [209] {105}	4,391 (878) [211] {105}
Tompkins	3,015	3,044	3,057	3,100	3,149 (630) [151] {76}	3,199 (640) [154] {77}	3,248 (650) [156] {78}
Ulster	8,858	8,899	8,909	8,955	9,075 (1,815) [436] {218}	9,188 (1,838) [441] {221}	9,294 (1,859) [446] {223}
Westchester	94,698	95,303	95,642	95,989	97,094 (19,419) [4,661] {2,330}	98,119 (19,624) [4,710] {2,355}	99,101 (19,820) [4,757] {2,378}

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.