IEM's AI Modeling: Short-term COVID-19 Projections

Date: 2/1/21

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 not 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 2/1/21 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.

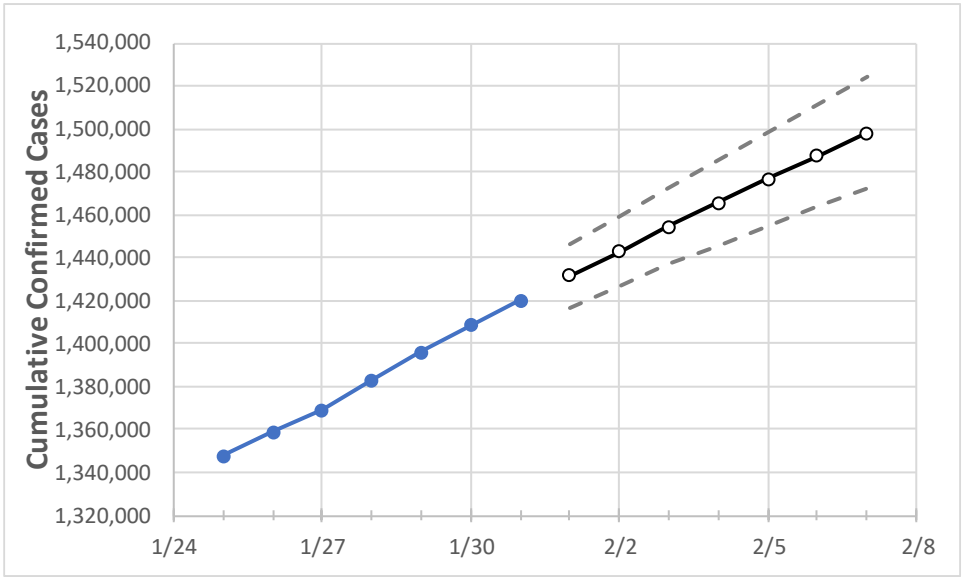
IEM's Modeling Lead

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:						
	1/28	1/29	1/30	1/31	2/1	2/2	2/3	2/4	2/5	2/6	2/7
New York	1,382,855	1,395,806	1,408,698	1,419,907	1,431,646	1,443,082	1,454,524	1,465,755	1,476,627	1,487,313	1,498,062

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:						
	1/28	1/29	1/30	1/31	2/1	2/2	2/3	2/4	2/5	2/6	2/7
Albany	18,189	18,359	18,519	18,701	18,871	19,037	19,199	19,359	19,516	19,672	19,826
Bronx	116,058	117,347	118,551	119,673	120,819	121,958	123,114	124,267	125,407	126,565	127,701
Dutchess	18,553	18,749	18,968	19,123	19,298	19,467	19,640	19,804	19,965	20,128	20,286
Erie	56,080	56,576	56,974	57,406	57,791	58,170	58,539	58,910	59,258	59,615	59,960
Kings	169,991	171,751	173,663	175,232	176,861	178,495	180,122	181,759	183,364	184,973	186,562
Monroe	47,195	47,464	47,721	47,996	48,227	48,454	48,673	48,885	49,087	49,283	49,477
Nassau	125,370	126,604	127,743	128,735	129,783	130,816	131,841	132,851	133,857	134,832	135,802
New York	83,103	84,053	84,931	85,779	86,626	87,490	88,344	89,209	90,081	90,961	91,833
Niagara	13,350	13,482	13,590	13,690	13,802	13,911	14,017	14,123	14,226	14,320	14,415
Onondaga	29,588	29,690	29,860	30,054	30,201	30,340	30,476	30,601	30,724	30,840	30,951
Orange	31,378	31,626	32,067	32,239	32,516	32,794	33,071	33,348	33,619	33,893	34,166
Putnam	7,171	7,239	7,293	7,338	7,396	7,453	7,509	7,564	7,617	7,668	7,719
Queens	172,995	174,769	176,534	178,112	179,679	181,266	182,821	184,416	185,984	187,553	189,078
Rensselaer	7,720	7,807	7,874	7,960	8,033	8,103	8,171	8,237	8,301	8,363	8,423
Richmond	48,691	49,068	49,422	49,736	50,064	50,387	50,697	51,001	51,298	51,589	51,864
Rockland	33,995	34,174	34,465	34,589	34,798	35,006	35,213	35,419	35,622	35,827	36,033
Saratoga	10,304	10,390	10,475	10,548	10,632	10,711	10,786	10,859	10,927	10,994	11,057
Schenectady	9,529	9,602	9,679	9,764	9,835	9,902	9,969	10,031	10,093	10,152	10,208
Suffolk	140,113	141,354	142,484	143,498	144,568	145,615	146,655	147,664	148,650	149,613	150,550
Sullivan	4,122	4,154	4,195	4,205	4,232	4,258	4,285	4,310	4,335	4,359	4,383
Tompkins	2,917	2,944	2,962	2,987	3,010	3,033	3,055	3,077	3,098	3,120	3,140
Ulster	8,533	8,615	8,716	8,778	8,858	8,937	9,015	9,093	9,171	9,247	9,321
Westchester	92,062	92,794	93,585	94,214	94,939	95,676	96,386	97,094	97,799	98,504	99,188

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:		
	1/28	1/29	1/30	1/31	2/2	2/4	2/6
Albany	18,189	18,359	18,519	18,701	19,037 (3,807) [914] {457}	19,359 (3,872) [929] {465}	19,672 (3,934) [944] {472}
Bronx	116,058	117,347	118,551	119,673	121,958 (24,392) [5,854] {2,927}	124,267 (24,853) [5,965] {2,982}	126,565 (25,313) [6,075] {3,038}
Dutchess	18,553	18,749	18,968	19,123	19,467 (3,893) [934] {467}	19,804 (3,961) [951] {475}	20,128 (4,026) [966] {483}
Erie	56,080	56,576	56,974	57,406	58,170 (11,634) [2,792] {1,396}	58,910 (11,782) [2,828] {1,414}	59,615 (11,923) [2,861] {1,431}
Kings	169,991	171,751	173,663	175,232	178,495 (35,699) [8,568] {4,284}	181,759 (36,352) [8,724] {4,362}	184,973 (36,995) [8,879] {4,439}
Monroe	47,195	47,464	47,721	47,996	48,454 (9,691) [2,326] {1,163}	48,885 (9,777) [2,346] {1,173}	49,283 (9,857) [2,366] {1,183}
Nassau	125,370	126,604	127,743	128,735	130,816 (26,163) [6,279] {3,140}	132,851 (26,570) [6,377] {3,188}	134,832 (26,966) [6,472] {3,236}
New York	83,103	84,053	84,931	85,779	87,490 (17,498) [4,199] {2,100}	89,209 (17,842) [4,282] {2,141}	90,961 (18,192) [4,366] {2,183}
Niagara	13,350	13,482	13,590	13,690	13,911 (2,782) [668] {334}	14,123 (2,825) [678] {339}	14,320 (2,864) [687] {344}
Onondaga	29,588	29,690	29,860	30,054	30,340 (6,068) [1,456] {728}	30,601 (6,120) [1,469] {734}	30,840 (6,168) [1,480] {740}
Orange	31,378	31,626	32,067	32,239	32,794 (6,559) [1,574] {787}	33,348 (6,670) [1,601] {800}	33,893 (6,779) [1,627] {813}
Putnam	7,171	7,239	7,293	7,338	7,453 (1,491) [358] {179}	7,564 (1,513) [363] {182}	7,668 (1,534) [368] {184}
Queens	172,995	174,769	176,534	178,112	181,266 (36,253) [8,701] {4,350}	184,416 (36,883) [8,852] {4,426}	187,553 (37,511) [9,003] {4,501}
Rensselaer	7,720	7,807	7,874	7,960	8,103 (1,621) [389] {194}	8,237 (1,647) [395] {198}	8,363 (1,673) [401] {201}
Richmond	48,691	49,068	49,422	49,736	50,387 (10,077) [2,419] {1,209}	51,001 (10,200) [2,448] {1,224}	51,589 (10,318) [2,476] {1,238}
Rockland	33,995	34,174	34,465	34,589	35,006 (7,001) [1,680] {840}	35,419 (7,084) [1,700] {850}	35,827 (7,165) [1,720] {860}
Saratoga	10,304	10,390	10,475	10,548	10,711 (2,142) [514] {257}	10,859 (2,172) [521] {261}	10,994 (2,199) [528] {264}
Schenectady	9,529	9,602	9,679	9,764	9,902 (1,980) [475] {238}	10,031 (2,006) [481] {241}	10,152 (2,030) [487] {244}
Suffolk	140,113	141,354	142,484	143,498	145,615 (29,123) [6,990] {3,495}	147,664 (29,533) [7,088] {3,544}	149,613 (29,923) [7,181] {3,591}
Sullivan	4,122	4,154	4,195	4,205	4,258 (852) [204] {102}	4,310 (862) [207] {103}	4,359 (872) [209] {105}
Tompkins	2,917	2,944	2,962	2,987	3,033 (607) [146] {73}	3,077 (615) [148] {74}	3,120 (624) [150] {75}
Ulster	8,533	8,615	8,716	8,778	8,937 (1,787) [429] {214}	9,093 (1,819) [436] {218}	9,247 (1,849) [444] {222}
Westchester	92,062	92,794	93,585	94,214	95,676 (19,135) [4,592] {2,296}	97,094 (19,419) [4,661] {2,330}	98,504 (19,701) [4,728] {2,364}

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.