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

Date: 2/2/21

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 2/2/21 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.

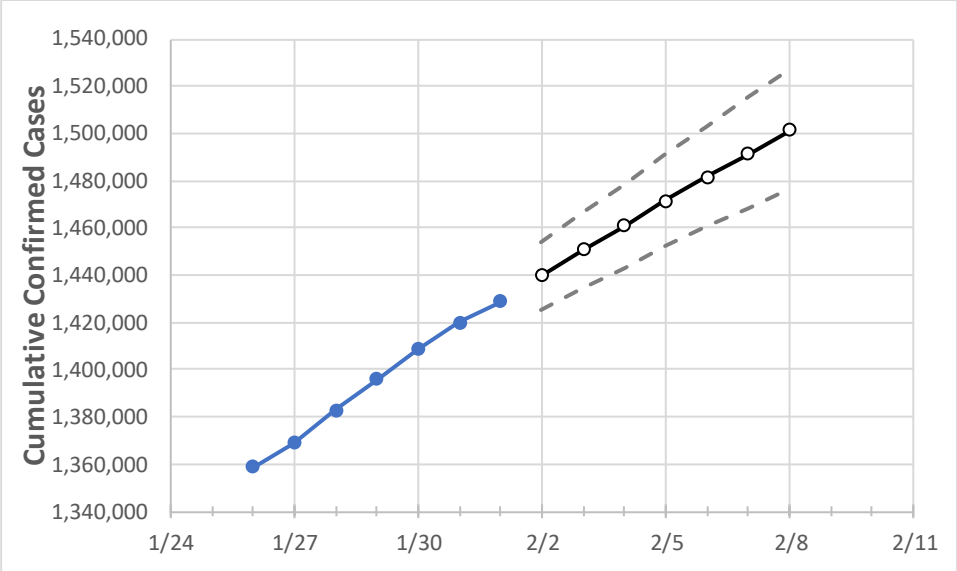
IEM's Modeling Lead

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:						
	1/29	1/30	1/31	2/1	2/2	2/3	2/4	2/5	2/6	2/7	2/8
New York	1,395,806	1,408,698	1,419,907	1,428,839	1,439,798	1,450,670	1,461,142	1,471,443	1,481,624	1,491,498	1,501,313

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:						
	1/29	1/30	1/31	2/1	2/2	2/3	2/4	2/5	2/6	2/7	2/8
Albany	18,359	18,519	18,701	18,771	18,924	19,072	19,214	19,353	19,488	19,621	19,755
Bronx	117,347	118,551	119,673	120,674	121,811	122,951	124,074	125,206	126,334	127,478	128,608
Dutchess	18,749	18,968	19,123	19,296	19,469	19,636	19,799	19,962	20,123	20,273	20,428
Erie	56,576	56,974	57,406	57,642	58,007	58,366	58,719	59,070	59,404	59,726	60,042
Kings	171,751	173,663	175,232	176,617	178,228	179,834	181,407	182,985	184,545	186,108	187,657
Monroe	47,464	47,721	47,996	48,163	48,387	48,599	48,804	49,002	49,188	49,368	49,541
Nassau	126,604	127,743	128,735	129,654	130,639	131,610	132,573	133,507	134,419	135,329	136,210
New York	84,053	84,931	85,779	86,431	87,238	88,047	88,840	89,642	90,444	91,240	92,041
Niagara	13,482	13,590	13,690	13,752	13,853	13,953	14,052	14,146	14,238	14,330	14,414
Onondaga	29,690	29,860	30,054	30,124	30,259	30,389	30,511	30,631	30,746	30,857	30,960
Orange	31,626	32,067	32,239	32,407	32,660	32,909	33,155	33,398	33,642	33,878	34,115
Putnam	7,239	7,293	7,338	7,384	7,439	7,494	7,546	7,598	7,648	7,698	7,747
Queens	174,769	176,534	178,112	179,401	180,925	182,431	183,932	185,407	186,870	188,339	189,778
Rensselaer	7,807	7,874	7,960	8,006	8,074	8,140	8,204	8,268	8,326	8,383	8,437
Richmond	49,068	49,422	49,736	50,025	50,342	50,648	50,947	51,238	51,527	51,808	52,077
Rockland	34,174	34,465	34,589	34,704	34,895	35,083	35,268	35,450	35,638	35,820	35,995
Saratoga	10,390	10,475	10,548	10,604	10,679	10,750	10,823	10,891	10,955	11,013	11,074
Schenectady	9,602	9,679	9,764	9,798	9,862	9,922	9,982	10,038	10,091	10,143	10,191
Suffolk	141,354	142,484	143,498	144,337	145,345	146,317	147,259	148,190	149,080	149,953	150,796
Sullivan	4,154	4,195	4,205	4,221	4,245	4,268	4,291	4,313	4,335	4,356	4,377
Tompkins	2,944	2,962	2,987	3,015	3,038	3,061	3,084	3,106	3,128	3,149	3,169
Ulster	8,615	8,716	8,778	8,858	8,938	9,017	9,094	9,171	9,247	9,322	9,394
Westchester	92,794	93,585	94,214	94,698	95,380	96,061	96,725	97,383	98,036	98,677	99,297

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:		
	1/29	1/30	1/31	2/1	2/3	2/5	2/7
Albany	18,359	18,519	18,701	18,771	19,072 (3,814) [915] {458}	19,353 (3,871) [929] {464}	19,621 (3,924) [942] {471}
Bronx	117,347	118,551	119,673	120,674	122,951 (24,590) [5,902] {2,951}	125,206 (25,041) [6,010] {3,005}	127,478 (25,496) [6,119] {3,059}
Dutchess	18,749	18,968	19,123	19,296	19,636 (3,927) [943] {471}	19,962 (3,992) [958] {479}	20,273 (4,055) [973] {487}
Erie	56,576	56,974	57,406	57,642	58,366 (11,673) [2,802] {1,401}	59,070 (11,814) [2,835] {1,418}	59,726 (11,945) [2,867] {1,433}
Kings	171,751	173,663	175,232	176,617	179,834 (35,967) [8,632] {4,316}	182,985 (36,597) [8,783] {4,392}	186,108 (37,222) [8,933] {4,467}
Monroe	47,464	47,721	47,996	48,163	48,599 (9,720) [2,333] {1,166}	49,002 (9,800) [2,352] {1,176}	49,368 (9,874) [2,370] {1,185}
Nassau	126,604	127,743	128,735	129,654	131,610 (26,322) [6,317] {3,159}	133,507 (26,701) [6,408] {3,204}	135,329 (27,066) [6,496] {3,248}
New York	84,053	84,931	85,779	86,431	88,047 (17,609) [4,226] {2,113}	89,642 (17,928) [4,303] {2,151}	91,240 (18,248) [4,380] {2,190}
Niagara	13,482	13,590	13,690	13,752	13,953 (2,791) [670] {335}	14,146 (2,829) [679] {340}	14,330 (2,866) [688] {344}
Onondaga	29,690	29,860	30,054	30,124	30,389 (6,078) [1,459] {729}	30,631 (6,126) [1,470] {735}	30,857 (6,171) [1,481] {741}
Orange	31,626	32,067	32,239	32,407	32,909 (6,582) [1,580] {790}	33,398 (6,680) [1,603] {802}	33,878 (6,776) [1,626] {813}
Putnam	7,239	7,293	7,338	7,384	7,494 (1,499) [360] {180}	7,598 (1,520) [365] {182}	7,698 (1,540) [370] {185}
Queens	174,769	176,534	178,112	179,401	182,431 (36,486) [8,757] {4,378}	185,407 (37,081) [8,900] {4,450}	188,339 (37,668) [9,040] {4,520}
Rensselaer	7,807	7,874	7,960	8,006	8,140 (1,628) [391] {195}	8,268 (1,654) [397] {198}	8,383 (1,677) [402] {201}
Richmond	49,068	49,422	49,736	50,025	50,648 (10,130) [2,431] {1,216}	51,238 (10,248) [2,459] {1,230}	51,808 (10,362) [2,487] {1,243}
Rockland	34,174	34,465	34,589	34,704	35,083 (7,017) [1,684] {842}	35,450 (7,090) [1,702] {851}	35,820 (7,164) [1,719] {860}
Saratoga	10,390	10,475	10,548	10,604	10,750 (2,150) [516] {258}	10,891 (2,178) [523] {261}	11,013 (2,203) [529] {264}
Schenectady	9,602	9,679	9,764	9,798	9,922 (1,984) [476] {238}	10,038 (2,008) [482] {241}	10,143 (2,029) [487] {243}
Suffolk	141,354	142,484	143,498	144,337	146,317 (29,263) [7,023] {3,512}	148,190 (29,638) [7,113] {3,557}	149,953 (29,991) [7,198] {3,599}
Sullivan	4,154	4,195	4,205	4,221	4,268 (854) [205] {102}	4,313 (863) [207] {104}	4,356 (871) [209] {105}
Tompkins	2,944	2,962	2,987	3,015	3,061 (612) [147] {73}	3,106 (621) [149] {75}	3,149 (630) [151] {76}
Ulster	8,615	8,716	8,778	8,858	9,017 (1,803) [433] {216}	9,171 (1,834) [440] {220}	9,322 (1,864) [447] {224}
Westchester	92,794	93,585	94,214	94,698	96,061 (19,212) [4,611] {2,305}	97,383 (19,477) [4,674] {2,337}	98,677 (19,735) [4,736] {2,368}

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.