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

Date: 12/4/20

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 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 12/4/20 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.

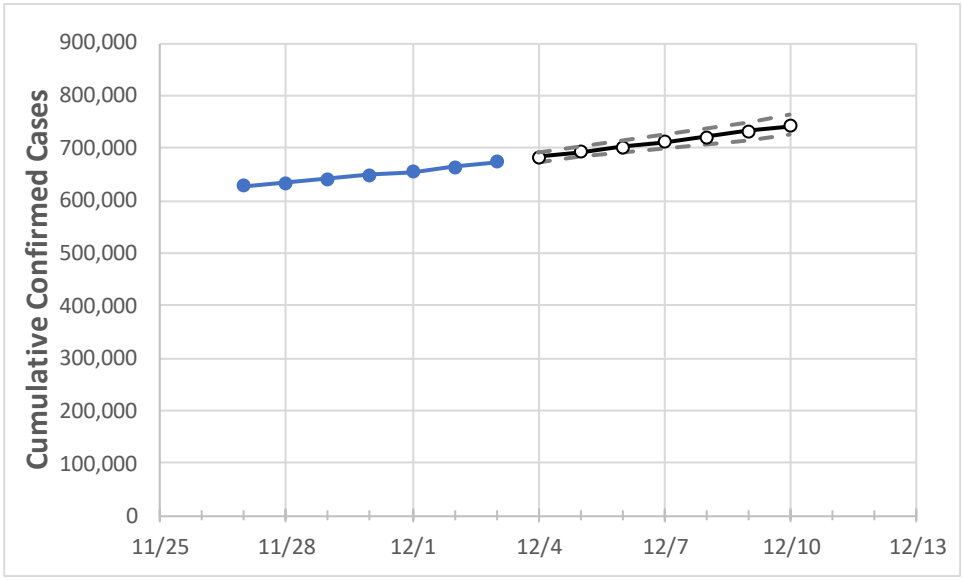
IEM's Modeling Lead

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:						
	11/30	12/1	12/2	12/3	12/4	12/5	12/6	12/7	12/8	12/9	12/10
New York	647,980	655,265	664,238	674,093	682,804	691,848	701,236	710,979	721,091	731,584	742,473

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:						
	11/30	12/1	12/2	12/3	12/4	12/5	12/6	12/7	12/8	12/9	12/10
Albany	5,816	5,968	6,138	6,258	6,394	6,537	6,686	6,843	7,007	7,179	7,358
Bronx	63,997	64,494	65,005	65,530	66,052	66,593	67,155	67,737	68,341	68,967	69,616
Dutchess	7,284	7,354	7,512	7,635	7,740	7,850	7,963	8,080	8,202	8,328	8,459
Erie	25,427	26,042	26,518	27,110	27,762	28,433	29,123	29,833	30,562	31,312	32,083
Kings	89,127	89,751	90,592	91,647	92,381	93,139	93,921	94,728	95,561	96,420	97,306
Monroe	15,660	16,060	16,588	17,127	17,679	18,256	18,861	19,495	20,158	20,853	21,580
Nassau	60,701	61,162	61,988	62,745	63,394	64,066	64,762	65,483	66,230	67,003	67,804
New York	45,442	45,871	46,328	46,858	47,338	47,832	48,340	48,862	49,398	49,950	50,517
Niagara	3,874	4,019	4,142	4,296	4,432	4,575	4,727	4,887	5,057	5,235	5,424
Onondaga	10,804	10,995	11,281	11,657	11,900	12,148	12,402	12,662	12,927	13,198	13,475
Orange	16,891	17,075	17,283	17,496	17,652	17,813	17,977	18,146	18,319	18,496	18,678
Putnam	2,844	2,884	2,973	3,038	3,089	3,143	3,201	3,262	3,327	3,395	3,468
Queens	90,398	91,056	91,955	92,813	93,577	94,368	95,188	96,036	96,915	97,825	98,766
Rensselaer	1,746	1,795	1,837	1,891	1,935	1,982	2,030	2,081	2,135	2,191	2,249
Richmond	23,015	23,376	23,866	24,205	24,557	24,925	25,308	25,708	26,125	26,560	27,013
Rockland	21,632	21,845	22,048	22,221	22,381	22,546	22,714	22,887	23,065	23,246	23,433
Saratoga	2,293	2,370	2,413	2,488	2,556	2,629	2,705	2,786	2,871	2,961	3,056
Schenectady	2,481	2,555	2,615	2,699	2,770	2,847	2,929	3,016	3,109	3,209	3,315
Suffolk	61,072	61,681	62,647	63,758	64,614	65,512	66,453	67,440	68,474	69,558	70,695
Sullivan	2,202	2,210	2,220	2,238	2,254	2,270	2,286	2,302	2,319	2,336	2,353
Tompkins	1,118	1,139	1,154	1,209	1,243	1,280	1,318	1,359	1,403	1,449	1,498
Ulster	3,381	3,434	3,499	3,606	3,677	3,752	3,833	3,918	4,009	4,106	4,209
Westchester	50,693	51,220	51,790	52,418	53,042	53,691	54,365	55,065	55,792	56,547	57,331

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:		
	11/30	12/1	12/2	12/3	12/5	12/7	12/9
Albany	5,816	5,968	6,138	6,258	6,537 (1,307) [314] {157}	6,843 (1,369) [328] {164}	7,179 (1,436) [345] {172}
Bronx	63,997	64,494	65,005	65,530	66,593 (13,319) [3,196] {1,598}	67,737 (13,547) [3,251] {1,626}	68,967 (13,793) [3,310] {1,655}
Dutchess	7,284	7,354	7,512	7,635	7,850 (1,570) [377] {188}	8,080 (1,616) [388] {194}	8,328 (1,666) [400] {200}
Erie	25,427	26,042	26,518	27,110	28,433 (5,687) [1,365] {682}	29,833 (5,967) [1,432] {716}	31,312 (6,262) [1,503] {751}
Kings	89,127	89,751	90,592	91,647	93,139 (18,628) [4,471] {2,235}	94,728 (18,946) [4,547] {2,273}	96,420 (19,284) [4,628] {2,314}
Monroe	15,660	16,060	16,588	17,127	18,256 (3,651) [876] {438}	19,495 (3,899) [936] {468}	20,853 (4,171) [1,001] {500}
Nassau	60,701	61,162	61,988	62,745	64,066 (12,813) [3,075] {1,538}	65,483 (13,097) [3,143] {1,572}	67,003 (13,401) [3,216] {1,608}
New York	45,442	45,871	46,328	46,858	47,832 (9,566) [2,296] {1,148}	48,862 (9,772) [2,345] {1,173}	49,950 (9,990) [2,398] {1,199}
Niagara	3,874	4,019	4,142	4,296	4,575 (915) [220] {110}	4,887 (977) [235] {117}	5,235 (1,047) [251] {126}
Onondaga	10,804	10,995	11,281	11,657	12,148 (2,430) [583] {292}	12,662 (2,532) [608] {304}	13,198 (2,640) [634] {317}
Orange	16,891	17,075	17,283	17,496	17,813 (3,563) [855] {428}	18,146 (3,629) [871] {435}	18,496 (3,699) [888] {444}
Putnam	2,844	2,884	2,973	3,038	3,143 (629) [151] {75}	3,262 (652) [157] {78}	3,395 (679) [163] {81}
Queens	90,398	91,056	91,955	92,813	94,368 (18,874) [4,530] {2,265}	96,036 (19,207) [4,610] {2,305}	97,825 (19,565) [4,696] {2,348}
Rensselaer	1,746	1,795	1,837	1,891	1,982 (396) [95] {48}	2,081 (416) [100] {50}	2,191 (438) [105] {53}
Richmond	23,015	23,376	23,866	24,205	24,925 (4,985) [1,196] {598}	25,708 (5,142) [1,234] {617}	26,560 (5,312) [1,275] {637}
Rockland	21,632	21,845	22,048	22,221	22,546 (4,509) [1,082] {541}	22,887 (4,577) [1,099] {549}	23,246 (4,649) [1,116] {558}
Saratoga	2,293	2,370	2,413	2,488	2,629 (526) [126] {63}	2,786 (557) [134] {67}	2,961 (592) [142] {71}
Schenectady	2,481	2,555	2,615	2,699	2,847 (569) [137] {68}	3,016 (603) [145] {72}	3,209 (642) [154] {77}
Suffolk	61,072	61,681	62,647	63,758	65,512 (13,102) [3,145] {1,572}	67,440 (13,488) [3,237] {1,619}	69,558 (13,912) [3,339] {1,669}
Sullivan	2,202	2,210	2,220	2,238	2,270 (454) [109] {54}	2,302 (460) [111] {55}	2,336 (467) [112] {56}
Tompkins	1,118	1,139	1,154	1,209	1,280 (256) [61] {31}	1,359 (272) [65] {33}	1,449 (290) [70] {35}
Ulster	3,381	3,434	3,499	3,606	3,752 (750) [180] {90}	3,918 (784) [188] {94}	4,106 (821) [197] {99}
Westchester	50,693	51,220	51,790	52,418	53,691 (10,738) [2,577] {1,289}	55,065 (11,013) [2,643] {1,322}	56,547 (11,309) [2,714] {1,357}

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.