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

Date: 3/5/21

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 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 3/5/21 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.

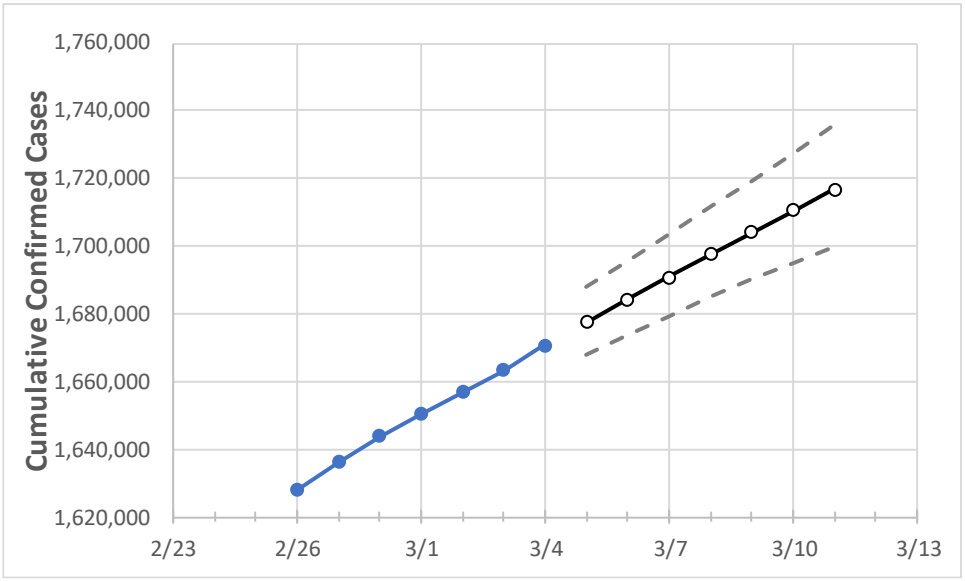
IEM's Modeling Lead

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:						
	3/1	3/2	3/3	3/4	3/5	3/6	3/7	3/8	3/9	3/10	3/11
New York	1,650,303	1,656,684	1,663,248	1,670,716	1,677,467	1,684,266	1,690,867	1,697,444	1,703,979	1,710,450	1,716,891

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:						
	3/1	3/2	3/3	3/4	3/5	3/6	3/7	3/8	3/9	3/10	3/11
Albany	20,890	20,931	20,985	21,030	21,078	21,125	21,169	21,212	21,256	21,297	21,337
Bronx	144,519	145,226	145,809	146,559	147,276	147,982	148,684	149,369	150,046	150,719	151,370
Dutchess	22,387	22,457	22,549	22,678	22,776	22,871	22,968	23,062	23,158	23,252	23,347
Erie	65,419	65,571	65,789	66,059	66,274	66,486	66,699	66,908	67,116	67,321	67,522
Kings	210,950	212,124	213,207	214,366	215,511	216,652	217,798	218,923	220,032	221,153	222,257
Monroe	52,679	52,759	52,878	52,990	53,104	53,216	53,325	53,433	53,538	53,640	53,744
Nassau	148,669	149,251	149,851	150,538	151,142	151,740	152,346	152,947	153,542	154,137	154,729
New York	103,922	104,444	104,874	105,491	106,067	106,644	107,212	107,778	108,343	108,894	109,454
Niagara	15,324	15,351	15,380	15,404	15,433	15,460	15,487	15,512	15,539	15,564	15,588
Onondaga	32,452	32,489	32,562	32,606	32,659	32,710	32,760	32,808	32,856	32,903	32,951
Orange	37,059	37,232	37,441	37,631	37,806	37,978	38,153	38,326	38,500	38,674	38,855
Putnam	8,369	8,389	8,418	8,460	8,488	8,517	8,545	8,572	8,600	8,627	8,655
Queens	211,812	212,927	213,800	214,905	215,956	217,014	218,067	219,096	220,138	221,154	222,179
Rensselaer	9,039	9,059	9,103	9,124	9,152	9,179	9,207	9,234	9,260	9,286	9,312
Richmond	57,201	57,405	57,617	57,895	58,132	58,364	58,595	58,826	59,053	59,285	59,514
Rockland	38,628	38,797	38,955	39,149	39,287	39,422	39,559	39,695	39,834	39,968	40,100
Saratoga	11,970	12,002	12,052	12,095	12,136	12,177	12,218	12,258	12,299	12,340	12,380
Schenectady	10,842	10,870	10,911	10,946	10,970	10,993	11,016	11,039	11,061	11,083	11,105
Suffolk	162,818	163,316	163,885	164,539	165,078	165,624	166,161	166,697	167,218	167,731	168,245
Sullivan	4,755	4,771	4,796	4,822	4,842	4,861	4,881	4,901	4,922	4,942	4,962
Tompkins	3,457	3,461	3,472	3,489	3,496	3,502	3,508	3,514	3,520	3,526	3,531
Ulster	10,069	10,096	10,146	10,206	10,246	10,287	10,328	10,369	10,409	10,451	10,492
Westchester	107,857	108,193	108,623	109,038	109,438	109,835	110,230	110,618	111,006	111,385	111,760

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:		
	3/1	3/2	3/3	3/4	3/6	3/8	3/10
Albany	20,890	20,931	20,985	21,030	21,125 (4,225) [1,014] {507}	21,212 (4,242) [1,018] {509}	21,297 (4,259) [1,022] {511}
Bronx	144,519	145,226	145,809	146,559	147,982 (29,596) [7,103] {3,552}	149,369 (29,874) [7,170] {3,585}	150,719 (30,144) [7,234] {3,617}
Dutchess	22,387	22,457	22,549	22,678	22,871 (4,574) [1,098] {549}	23,062 (4,612) [1,107] {553}	23,252 (4,650) [1,116] {558}
Erie	65,419	65,571	65,789	66,059	66,486 (13,297) [3,191] {1,596}	66,908 (13,382) [3,212] {1,606}	67,321 (13,464) [3,231] {1,616}
Kings	210,950	212,124	213,207	214,366	216,652 (43,330) [10,399] {5,200}	218,923 (43,785) [10,508] {5,254}	221,153 (44,231) [10,615] {5,308}
Monroe	52,679	52,759	52,878	52,990	53,216 (10,643) [2,554] {1,277}	53,433 (10,687) [2,565] {1,282}	53,640 (10,728) [2,575] {1,287}
Nassau	148,669	149,251	149,851	150,538	151,740 (30,348) [7,284] {3,642}	152,947 (30,589) [7,341] {3,671}	154,137 (30,827) [7,399] {3,699}
New York	103,922	104,444	104,874	105,491	106,644 (21,329) [5,119] {2,559}	107,778 (21,556) [5,173] {2,587}	108,894 (21,779) [5,227] {2,613}
Niagara	15,324	15,351	15,380	15,404	15,460 (3,092) [742] {371}	15,512 (3,102) [745] {372}	15,564 (3,113) [747] {374}
Onondaga	32,452	32,489	32,562	32,606	32,710 (6,542) [1,570] {785}	32,808 (6,562) [1,575] {787}	32,903 (6,581) [1,579] {790}
Orange	37,059	37,232	37,441	37,631	37,978 (7,596) [1,823] {911}	38,326 (7,665) [1,840] {920}	38,674 (7,735) [1,856] {928}
Putnam	8,369	8,389	8,418	8,460	8,517 (1,703) [409] {204}	8,572 (1,714) [411] {206}	8,627 (1,725) [414] {207}
Queens	211,812	212,927	213,800	214,905	217,014 (43,403) [10,417] {5,208}	219,096 (43,819) [10,517] {5,258}	221,154 (44,231) [10,615] {5,308}
Rensselaer	9,039	9,059	9,103	9,124	9,179 (1,836) [441] {220}	9,234 (1,847) [443] {222}	9,286 (1,857) [446] {223}
Richmond	57,201	57,405	57,617	57,895	58,364 (11,673) [2,801] {1,401}	58,826 (11,765) [2,824] {1,412}	59,285 (11,857) [2,846] {1,423}
Rockland	38,628	38,797	38,955	39,149	39,422 (7,884) [1,892] {946}	39,695 (7,939) [1,905] {953}	39,968 (7,994) [1,918] {959}
Saratoga	11,970	12,002	12,052	12,095	12,177 (2,435) [585] {292}	12,258 (2,452) [588] {294}	12,340 (2,468) [592] {296}
Schenectady	10,842	10,870	10,911	10,946	10,993 (2,199) [528] {264}	11,039 (2,208) [530] {265}	11,083 (2,217) [532] {266}
Suffolk	162,818	163,316	163,885	164,539	165,624 (33,125) [7,950] {3,975}	166,697 (33,339) [8,001] {4,001}	167,731 (33,546) [8,051] {4,026}
Sullivan	4,755	4,771	4,796	4,822	4,861 (972) [233] {117}	4,901 (980) [235] {118}	4,942 (988) [237] {119}
Tompkins	3,457	3,461	3,472	3,489	3,502 (700) [168] {84}	3,514 (703) [169] {84}	3,526 (705) [169] {85}
Ulster	10,069	10,096	10,146	10,206	10,287 (2,057) [494] {247}	10,369 (2,074) [498] {249}	10,451 (2,090) [502] {251}
Westchester	107,857	108,193	108,623	109,038	109,835 (21,967) [5,272] {2,636}	110,618 (22,124) [5,310] {2,655}	111,385 (22,277) [5,346] {2,673}

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.