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

Date: 1/13/21

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 1/13/21 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.

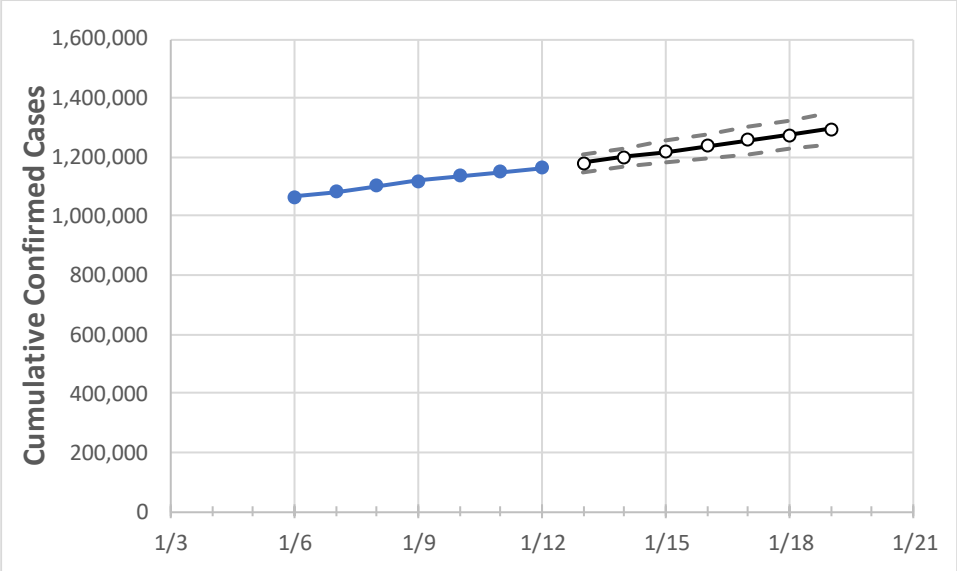
IEM's Modeling Lead

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:						
	1/9	1/10	1/11	1/12	1/13	1/14	1/15	1/16	1/17	1/18	1/19
New York	1,119,284	1,135,592	1,149,771	1,164,562	1,182,138	1,200,127	1,218,609	1,237,570	1,256,791	1,276,594	1,296,740

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:						
	1/9	1/10	1/11	1/12	1/13	1/14	1/15	1/16	1/17	1/18	1/19
Albany	13,930	14,196	14,411	14,763	15,051	15,347	15,646	15,947	16,257	16,566	16,885
Bronx	94,723	95,878	97,015	98,058	99,317	100,622	101,999	103,402	104,865	106,354	107,897
Dutchess	14,212	14,471	14,757	14,997	15,285	15,576	15,877	16,183	16,497	16,826	17,164
Erie	46,886	47,549	47,904	48,454	49,102	49,750	50,411	51,097	51,780	52,471	53,182
Kings	137,746	139,496	141,106	142,754	144,583	146,463	148,383	150,358	152,383	154,470	156,625
Monroe	39,555	40,293	40,693	41,157	41,763	42,370	42,985	43,596	44,204	44,814	45,419
Nassau	101,181	102,584	104,078	105,497	107,202	108,958	110,763	112,600	114,494	116,435	118,415
New York	67,692	68,604	69,504	70,193	71,057	71,939	72,837	73,770	74,714	75,682	76,690
Niagara	10,364	10,600	10,685	10,888	11,110	11,333	11,558	11,788	12,023	12,266	12,509
Onondaga	24,668	25,057	25,366	25,626	26,009	26,394	26,790	27,192	27,586	27,996	28,392
Orange	25,938	26,260	26,488	26,787	27,120	27,457	27,794	28,147	28,496	28,851	29,212
Putnam	5,645	5,750	5,844	5,930	6,040	6,152	6,267	6,383	6,505	6,628	6,754
Queens	140,744	142,648	144,291	145,897	147,900	149,961	152,108	154,267	156,517	158,820	161,182
Rensselaer	5,566	5,714	5,860	6,040	6,215	6,392	6,578	6,767	6,962	7,163	7,369
Richmond	40,109	40,659	41,122	41,711	42,356	43,012	43,687	44,386	45,090	45,805	46,553
Rockland	29,660	29,827	30,015	30,273	30,523	30,772	31,032	31,293	31,554	31,822	32,095
Saratoga	7,511	7,753	7,960	8,124	8,373	8,634	8,903	9,176	9,460	9,752	10,053
Schenectady	7,284	7,453	7,619	7,759	7,927	8,097	8,267	8,440	8,618	8,794	8,975
Suffolk	112,211	113,943	115,489	117,156	119,188	121,243	123,339	125,434	127,593	129,832	132,096
Sullivan	3,454	3,488	3,519	3,570	3,611	3,651	3,692	3,733	3,774	3,814	3,857
Tompkins	2,374	2,396	2,414	2,424	2,451	2,478	2,506	2,534	2,562	2,590	2,618
Ulster	6,677	6,835	6,927	7,038	7,167	7,299	7,438	7,581	7,726	7,879	8,030
Westchester	76,942	77,731	78,534	79,406	80,331	81,284	82,239	83,235	84,223	85,240	86,281

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:		
	1/9	1/10	1/11	1/12	1/14	1/16	1/18
Albany	13,930	14,196	14,411	14,763	15,347 (3,069) [737] {368}	15,947 (3,189) [765] {383}	16,566 (3,313) [795] {398}
Bronx	94,723	95,878	97,015	98,058	100,622 (20,124) [4,830] {2,415}	103,402 (20,680) [4,963] {2,482}	106,354 (21,271) [5,105] {2,552}
Dutchess	14,212	14,471	14,757	14,997	15,576 (3,115) [748] {374}	16,183 (3,237) [777] {388}	16,826 (3,365) [808] {404}
Erie	46,886	47,549	47,904	48,454	49,750 (9,950) [2,388] {1,194}	51,097 (10,219) [2,453] {1,226}	52,471 (10,494) [2,519] {1,259}
Kings	137,746	139,496	141,106	142,754	146,463 (29,293) [7,030] {3,515}	150,358 (30,072) [7,217] {3,609}	154,470 (30,894) [7,415] {3,707}
Monroe	39,555	40,293	40,693	41,157	42,370 (8,474) [2,034] {1,017}	43,596 (8,719) [2,093] {1,046}	44,814 (8,963) [2,151] {1,076}
Nassau	101,181	102,584	104,078	105,497	108,958 (21,792) [5,230] {2,615}	112,600 (22,520) [5,405] {2,702}	116,435 (23,287) [5,589] {2,794}
New York	67,692	68,604	69,504	70,193	71,939 (14,388) [3,453] {1,727}	73,770 (14,754) [3,541] {1,770}	75,682 (15,136) [3,633] {1,816}
Niagara	10,364	10,600	10,685	10,888	11,333 (2,267) [544] {272}	11,788 (2,358) [566] {283}	12,266 (2,453) [589] {294}
Onondaga	24,668	25,057	25,366	25,626	26,394 (5,279) [1,267] {633}	27,192 (5,438) [1,305] {653}	27,996 (5,599) [1,344] {672}
Orange	25,938	26,260	26,488	26,787	27,457 (5,491) [1,318] {659}	28,147 (5,629) [1,351] {676}	28,851 (5,770) [1,385] {692}
Putnam	5,645	5,750	5,844	5,930	6,152 (1,230) [295] {148}	6,383 (1,277) [306] {153}	6,628 (1,326) [318] {159}
Queens	140,744	142,648	144,291	145,897	149,961 (29,992) [7,198] {3,599}	154,267 (30,853) [7,405] {3,702}	158,820 (31,764) [7,623] {3,812}
Rensselaer	5,566	5,714	5,860	6,040	6,392 (1,278) [307] {153}	6,767 (1,353) [325] {162}	7,163 (1,433) [344] {172}
Richmond	40,109	40,659	41,122	41,711	43,012 (8,602) [2,065] {1,032}	44,386 (8,877) [2,131] {1,065}	45,805 (9,161) [2,199] {1,099}
Rockland	29,660	29,827	30,015	30,273	30,772 (6,154) [1,477] {739}	31,293 (6,259) [1,502] {751}	31,822 (6,364) [1,527] {764}
Saratoga	7,511	7,753	7,960	8,124	8,634 (1,727) [414] {207}	9,176 (1,835) [440] {220}	9,752 (1,950) [468] {234}
Schenectady	7,284	7,453	7,619	7,759	8,097 (1,619) [389] {194}	8,440 (1,688) [405] {203}	8,794 (1,759) [422] {211}
Suffolk	112,211	113,943	115,489	117,156	121,243 (24,249) [5,820] {2,910}	125,434 (25,087) [6,021] {3,010}	129,832 (25,966) [6,232] {3,116}
Sullivan	3,454	3,488	3,519	3,570	3,651 (730) [175] {88}	3,733 (747) [179] {90}	3,814 (763) [183] {92}
Tompkins	2,374	2,396	2,414	2,424	2,478 (496) [119] {59}	2,534 (507) [122] {61}	2,590 (518) [124] {62}
Ulster	6,677	6,835	6,927	7,038	7,299 (1,460) [350] {175}	7,581 (1,516) [364] {182}	7,879 (1,576) [378] {189}
Westchester	76,942	77,731	78,534	79,406	81,284 (16,257) [3,902] {1,951}	83,235 (16,647) [3,995] {1,998}	85,240 (17,048) [4,092] {2,046}

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.