

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.

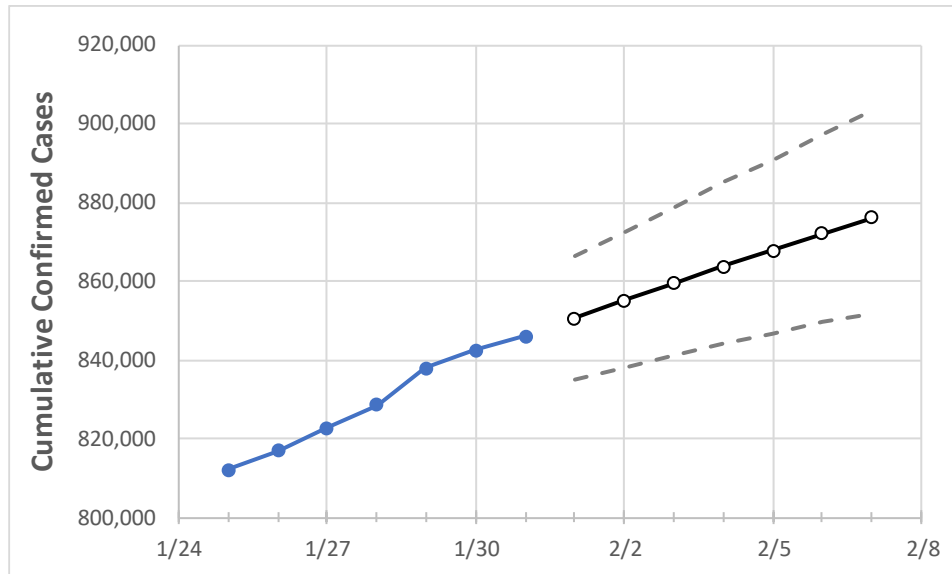
IEM's Modeling Lead

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.

Pennsylvania 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
Pennsylvania	828,632	838,016	842,475	846,046	850,565	855,016	859,303	863,715	867,887	872,060	876,181

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.

Pennsylvania 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
Allegheny	68,445	68,809	69,135	69,368	69,650	69,925	70,194	70,456	70,705	70,943	71,171
Berks	30,822	32,287	32,481	32,577	32,882	33,189	33,507	33,824	34,146	34,464	34,781
Bucks	38,977	39,657	39,925	40,193	40,491	40,795	41,096	41,407	41,715	42,032	42,354
Butler	12,566	12,651	12,695	12,736	12,793	12,848	12,899	12,950	12,997	13,043	13,088
Chester	25,081	25,207	25,207	25,207	25,323	25,430	25,537	25,640	25,743	25,841	25,936
Delaware	36,636	37,027	37,190	37,339	37,530	37,719	37,907	38,095	38,278	38,462	38,642
Lackawanna	12,201	12,285	12,367	12,398	12,471	12,540	12,608	12,672	12,736	12,796	12,854
Lancaster	36,945	37,912	38,168	38,485	38,829	39,177	39,526	39,870	40,224	40,590	40,950
Lehigh	27,532	27,820	28,015	28,135	28,298	28,459	28,618	28,768	28,920	29,067	29,219
Luzerne	22,412	22,542	22,725	22,882	23,027	23,174	23,320	23,469	23,619	23,765	23,912
Monroe	8,401	8,469	8,545	8,595	8,651	8,707	8,761	8,815	8,867	8,919	8,971
Montgomery	47,100	48,029	48,329	48,612	48,978	49,347	49,720	50,085	50,453	50,817	51,184
Northampton	22,687	23,135	23,315	23,443	23,645	23,847	24,052	24,254	24,458	24,661	24,863
Philadelphia	108,760	109,231	109,231	109,231	109,598	109,969	110,331	110,664	110,995	111,329	111,652
Westmoreland	24,456	24,576	24,661	24,703	24,777	24,845	24,910	24,971	25,032	25,088	25,140
York	31,218	31,670	31,889	32,142	32,387	32,624	32,870	33,116	33,357	33,600	33,839

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.

Pennsylvania 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					
Allegheny	68,445	68,809	69,135	69,368	69,925	(13,985)	[3,356]	{1,678}	70,456	(14,091)	[3,382]	{1,691}	70,943	(14,189)	[3,405]	{1,703}
Berks	30,822	32,287	32,481	32,577	33,189	(6,638)	[1,593]	{797}	33,824	(6,765)	[1,624]	{812}	34,464	(6,893)	[1,654]	{827}
Bucks	38,977	39,657	39,925	40,193	40,795	(8,159)	[1,958]	{979}	41,407	(8,281)	[1,988]	{994}	42,032	(8,406)	[2,018]	{1,009}
Butler	12,566	12,651	12,695	12,736	12,848	(2,570)	[617]	{308}	12,950	(2,590)	[622]	{311}	13,043	(2,609)	[626]	{313}
Chester	25,081	25,207	25,207	25,207	25,430	(5,086)	[1,221]	{610}	25,640	(5,128)	[1,231]	{615}	25,841	(5,168)	[1,240]	{620}
Delaware	36,636	37,027	37,190	37,339	37,719	(7,544)	[1,811]	{905}	38,095	(7,619)	[1,829]	{914}	38,462	(7,692)	[1,846]	{923}
Lackawanna	12,201	12,285	12,367	12,398	12,540	(2,508)	[602]	{301}	12,672	(2,534)	[608]	{304}	12,796	(2,559)	[614]	{307}
Lancaster	36,945	37,912	38,168	38,485	39,177	(7,835)	[1,881]	{940}	39,870	(7,974)	[1,914]	{957}	40,590	(8,118)	[1,948]	{974}
Lehigh	27,532	27,820	28,015	28,135	28,459	(5,692)	[1,366]	{683}	28,768	(5,754)	[1,381]	{690}	29,067	(5,813)	[1,395]	{698}
Luzerne	22,412	22,542	22,725	22,882	23,174	(4,635)	[1,112]	{556}	23,469	(4,694)	[1,127]	{563}	23,765	(4,753)	[1,141]	{570}
Monroe	8,401	8,469	8,545	8,595	8,707	(1,741)	[418]	{209}	8,815	(1,763)	[423]	{212}	8,919	(1,784)	[428]	{214}
Montgomery	47,100	48,029	48,329	48,612	49,347	(9,869)	[2,369]	{1,184}	50,085	(10,017)	[2,404]	{1,202}	50,817	(10,163)	[2,439]	{1,220}
Northampton	22,687	23,135	23,315	23,443	23,847	(4,769)	[1,145]	{572}	24,254	(4,851)	[1,164]	{582}	24,661	(4,932)	[1,184]	{592}
Philadelphia	108,760	109,231	109,231	109,231	109,969	(21,994)	[5,278]	{2,639}	110,664	(22,133)	[5,312]	{2,656}	111,329	(22,266)	[5,344]	{2,672}
Westmoreland	24,456	24,576	24,661	24,703	24,845	(4,969)	[1,193]	{596}	24,971	(4,994)	[1,199]	{599}	25,088	(5,018)	[1,204]	{602}
York	31,218	31,670	31,889	32,142	32,624	(6,525)	[1,566]	{783}	33,116	(6,623)	[1,590]	{795}	33,600	(6,720)	[1,613]	{806}

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.