

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

Date: 12/20/21

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 12/20/21 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.

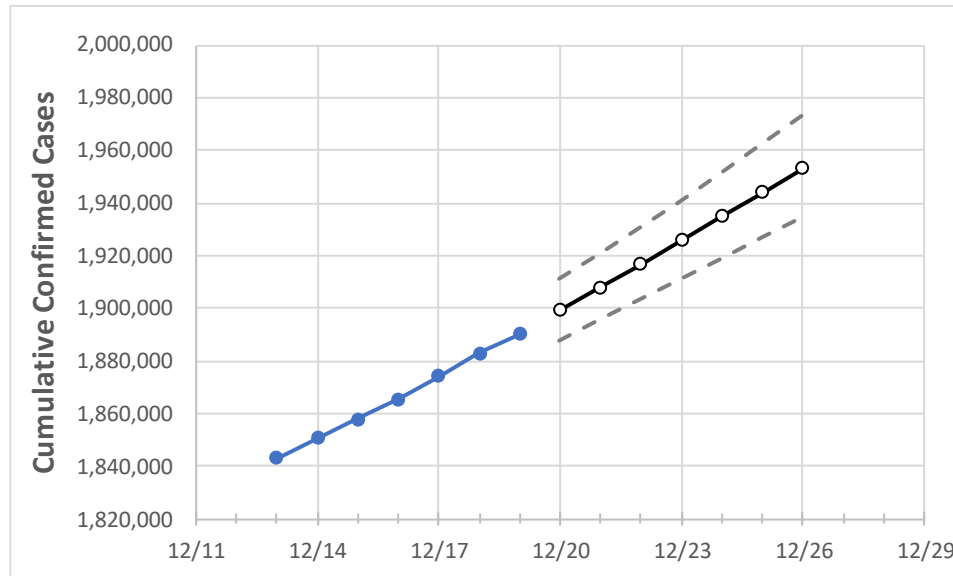
IEM's Modeling Lead

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:						
	12/16	12/17	12/18	12/19	12/20	12/21	12/22	12/23	12/24	12/25	12/26
Pennsylvania	1,865,568	1,874,197	1,883,028	1,890,259	1,899,160	1,907,997	1,916,726	1,925,762	1,934,836	1,944,078	1,953,351

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:						
	12/16	12/17	12/18	12/19	12/20	12/21	12/22	12/23	12/24	12/25	12/26
Allegheny	161,085	161,862	162,514	163,022	163,674	164,324	164,947	165,610	166,255	166,911	167,564
Berks	70,182	70,540	70,907	71,245	71,641	72,039	72,429	72,841	73,252	73,686	74,118
Bucks	84,083	84,459	84,914	85,199	85,617	86,042	86,479	86,934	87,392	87,857	88,334
Butler	30,969	31,069	31,163	31,248	31,351	31,451	31,548	31,644	31,743	31,838	31,931
Chester	59,688	60,010	60,414	60,720	61,075	61,436	61,813	62,193	62,584	62,997	63,409
Delaware	69,868	70,201	70,552	70,858	71,184	71,518	71,855	72,203	72,566	72,934	73,318
Lackawanna	27,395	27,529	27,665	27,781	27,922	28,062	28,204	28,355	28,506	28,654	28,806
Lancaster	84,155	84,477	84,775	85,229	85,616	85,997	86,395	86,790	87,197	87,611	88,021
Lehigh	57,650	57,909	58,253	58,502	58,837	59,177	59,526	59,874	60,230	60,605	60,973
Luzerne	49,602	49,842	50,046	50,240	50,474	50,711	50,939	51,179	51,417	51,663	51,904
Monroe	23,658	23,733	23,877	23,979	24,108	24,237	24,370	24,503	24,637	24,778	24,922
Montgomery	99,151	99,609	100,093	100,565	101,085	101,620	102,153	102,709	103,275	103,864	104,458
Northampton	52,929	53,179	53,535	53,806	54,138	54,477	54,813	55,154	55,518	55,890	56,261
Philadelphia	200,668	201,709	202,708	203,281	204,173	205,037	205,956	206,894	207,934	208,962	210,019
Westmoreland	55,847	56,137	56,317	56,487	56,735	56,977	57,217	57,462	57,708	57,961	58,207
York	76,480	76,873	77,358	77,823	78,254	78,696	79,142	79,594	80,058	80,524	81,000

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:											
	12/16	12/17	12/18	12/19	12/21			12/23			12/25					
Allegheny	161,085	161,862	162,514	163,022	164,324	(32,865)	[7,888]	{3,944}	165,610	(33,122)	[7,949]	{3,975}	166,911	(33,382)	[8,012]	{4,006}
Berks	70,182	70,540	70,907	71,245	72,039	(14,408)	[3,458]	{1,729}	72,841	(14,568)	[3,496]	{1,748}	73,686	(14,737)	[3,537]	{1,768}
Bucks	84,083	84,459	84,914	85,199	86,042	(17,208)	[4,130]	{2,065}	86,934	(17,387)	[4,173]	{2,086}	87,857	(17,571)	[4,217]	{2,109}
Butler	30,969	31,069	31,163	31,248	31,451	(6,290)	[1,510]	{755}	31,644	(6,329)	[1,519]	{759}	31,838	(6,368)	[1,528]	{764}
Chester	59,688	60,010	60,414	60,720	61,436	(12,287)	[2,949]	{1,474}	62,193	(12,439)	[2,985]	{1,493}	62,997	(12,599)	[3,024]	{1,512}
Delaware	69,868	70,201	70,552	70,858	71,518	(14,304)	[3,433]	{1,716}	72,203	(14,441)	[3,466]	{1,733}	72,934	(14,587)	[3,501]	{1,750}
Lackawanna	27,395	27,529	27,665	27,781	28,062	(5,612)	[1,347]	{673}	28,355	(5,671)	[1,361]	{681}	28,654	(5,731)	[1,375]	{688}
Lancaster	84,155	84,477	84,775	85,229	85,997	(17,199)	[4,128]	{2,064}	86,790	(17,358)	[4,166]	{2,083}	87,611	(17,522)	[4,205]	{2,103}
Lehigh	57,650	57,909	58,253	58,502	59,177	(11,835)	[2,840]	{1,420}	59,874	(11,975)	[2,874]	{1,437}	60,605	(12,121)	[2,909]	{1,455}
Luzerne	49,602	49,842	50,046	50,240	50,711	(10,142)	[2,434]	{1,217}	51,179	(10,236)	[2,457]	{1,228}	51,663	(10,333)	[2,480]	{1,240}
Monroe	23,658	23,733	23,877	23,979	24,237	(4,847)	[1,163]	{582}	24,503	(4,901)	[1,176]	{588}	24,778	(4,956)	[1,189]	{595}
Montgomery	99,151	99,609	100,093	100,565	101,620	(20,324)	[4,878]	{2,439}	102,709	(20,542)	[4,930]	{2,465}	103,864	(20,773)	[4,985]	{2,493}
Northampton	52,929	53,179	53,535	53,806	54,477	(10,895)	[2,615]	{1,307}	55,154	(11,031)	[2,647]	{1,324}	55,890	(11,178)	[2,683]	{1,341}
Philadelphia	200,668	201,709	202,708	203,281	205,037	(41,007)	[9,842]	{4,921}	206,894	(41,379)	[9,931]	{4,965}	208,962	(41,792)	[10,030]	{5,015}
Westmoreland	55,847	56,137	56,317	56,487	56,977	(11,395)	[2,735]	{1,367}	57,462	(11,492)	[2,758]	{1,379}	57,961	(11,592)	[2,782]	{1,391}
York	76,480	76,873	77,358	77,823	78,696	(15,739)	[3,777]	{1,889}	79,594	(15,919)	[3,821]	{1,910}	80,524	(16,105)	[3,865]	{1,933}

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.