

IEM's AI Modeling: Short-term COVID-19 Projections**Date: 12/15/21**

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 12/15/21 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.

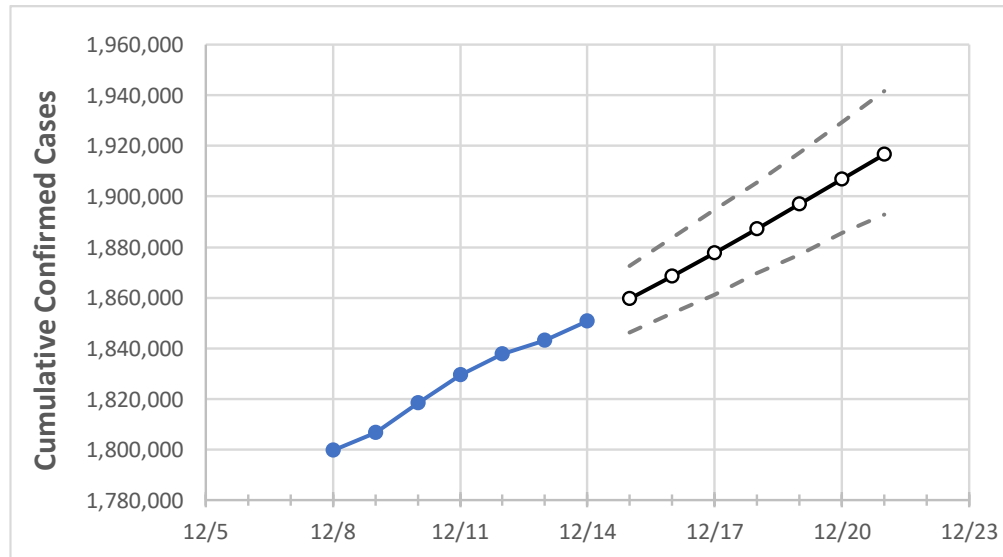
IEM's Modeling Lead

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:						
	12/11	12/12	12/13	12/14	12/15	12/16	12/17	12/18	12/19	12/20	12/21
Pennsylvania	1,829,351	1,837,742	1,843,137	1,850,578	1,859,518	1,868,430	1,877,694	1,887,116	1,896,928	1,906,690	1,916,614

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:						
	12/11	12/12	12/13	12/14	12/15	12/16	12/17	12/18	12/19	12/20	12/21
Allegheny	158,347	159,011	159,390	160,084	160,812	161,540	162,267	162,980	163,764	164,510	165,243
Berks	68,576	69,031	69,282	69,550	69,976	70,409	70,846	71,309	71,754	72,256	72,742
Bucks	82,569	82,917	83,124	83,414	83,812	84,225	84,654	85,092	85,547	86,028	86,502
Butler	30,522	30,622	30,685	30,799	30,930	31,056	31,191	31,315	31,446	31,578	31,702
Chester	58,320	58,556	58,779	59,056	59,370	59,692	60,022	60,361	60,715	61,071	61,432
Delaware	68,673	68,979	69,145	69,378	69,652	69,945	70,241	70,545	70,862	71,181	71,526
Lackawanna	26,762	26,864	26,962	27,095	27,221	27,352	27,485	27,617	27,752	27,892	28,035
Lancaster	82,430	82,858	83,158	83,431	83,834	84,239	84,648	85,067	85,503	85,944	86,374
Lehigh	56,202	56,526	56,795	57,085	57,439	57,796	58,154	58,527	58,916	59,323	59,729
Luzerne	48,526	48,770	48,920	49,135	49,381	49,624	49,875	50,124	50,380	50,638	50,900
Monroe	23,091	23,219	23,312	23,447	23,590	23,727	23,872	24,016	24,162	24,325	24,481
Montgomery	97,164	97,641	97,996	98,316	98,819	99,337	99,866	100,422	100,981	101,562	102,171
Northampton	51,563	51,917	52,131	52,376	52,705	53,045	53,394	53,755	54,129	54,514	54,904
Philadelphia	197,981	198,751	199,077	199,369	200,105	200,864	201,623	202,460	203,346	204,196	205,118
Westmoreland	54,697	54,988	55,104	55,435	55,714	56,004	56,285	56,573	56,859	57,148	57,462
York	74,629	75,136	75,451	75,757	76,178	76,585	77,016	77,452	77,881	78,334	78,789

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:											
	12/11	12/12	12/13	12/14	12/16				12/18				12/20			
Allegheny	158,347	159,011	159,390	160,084	161,540	(32,308)	[7,754]	{3,877}	162,980	(32,596)	[7,823]	{3,912}	164,510	(32,902)	[7,896]	{3,948}
Berks	68,576	69,031	69,282	69,550	70,409	(14,082)	[3,380]	{1,690}	71,309	(14,262)	[3,423]	{1,711}	72,256	(14,451)	[3,468]	{1,734}
Bucks	82,569	82,917	83,124	83,414	84,225	(16,845)	[4,043]	{2,021}	85,092	(17,018)	[4,084]	{2,042}	86,028	(17,206)	[4,129]	{2,065}
Butler	30,522	30,622	30,685	30,799	31,056	(6,211)	[1,491]	{745}	31,315	(6,263)	[1,503]	{752}	31,578	(6,316)	[1,516]	{758}
Chester	58,320	58,556	58,779	59,056	59,692	(11,938)	[2,865]	{1,433}	60,361	(12,072)	[2,897]	{1,449}	61,071	(12,214)	[2,931]	{1,466}
Delaware	68,673	68,979	69,145	69,378	69,945	(13,989)	[3,357]	{1,679}	70,545	(14,109)	[3,386]	{1,693}	71,181	(14,236)	[3,417]	{1,708}
Lackawanna	26,762	26,864	26,962	27,095	27,352	(5,470)	[1,313]	{656}	27,617	(5,523)	[1,326]	{663}	27,892	(5,578)	[1,339]	{669}
Lancaster	82,430	82,858	83,158	83,431	84,239	(16,848)	[4,043]	{2,022}	85,067	(17,013)	[4,083]	{2,042}	85,944	(17,189)	[4,125]	{2,063}
Lehigh	56,202	56,526	56,795	57,085	57,796	(11,559)	[2,774]	{1,387}	58,527	(11,705)	[2,809]	{1,405}	59,323	(11,865)	[2,848]	{1,424}
Luzerne	48,526	48,770	48,920	49,135	49,624	(9,925)	[2,382]	{1,191}	50,124	(10,025)	[2,406]	{1,203}	50,638	(10,128)	[2,431]	{1,215}
Monroe	23,091	23,219	23,312	23,447	23,727	(4,745)	[1,139]	{569}	24,016	(4,803)	[1,153]	{576}	24,325	(4,865)	[1,168]	{584}
Montgomery	97,164	97,641	97,996	98,316	99,337	(19,867)	[4,768]	{2,384}	100,422	(20,084)	[4,820]	{2,410}	101,562	(20,312)	[4,875]	{2,437}
Northampton	51,563	51,917	52,131	52,376	53,045	(10,609)	[2,546]	{1,273}	53,755	(10,751)	[2,580]	{1,290}	54,514	(10,903)	[2,617]	{1,308}
Philadelphia	197,981	198,751	199,077	199,369	200,864	(40,173)	[9,641]	{4,821}	202,460	(40,492)	[9,718]	{4,859}	204,196	(40,839)	[9,801]	{4,901}
Westmoreland	54,697	54,988	55,104	55,435	56,004	(11,201)	[2,688]	{1,344}	56,573	(11,315)	[2,715]	{1,358}	57,148	(11,430)	[2,743]	{1,372}
York	74,629	75,136	75,451	75,757	76,585	(15,317)	[3,676]	{1,838}	77,452	(15,490)	[3,718]	{1,859}	78,334	(15,667)	[3,760]	{1,880}

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.