

**IEM's AI Modeling: Short-term COVID-19 Projections****Date: 12/29/21**

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 12/29/21 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.**

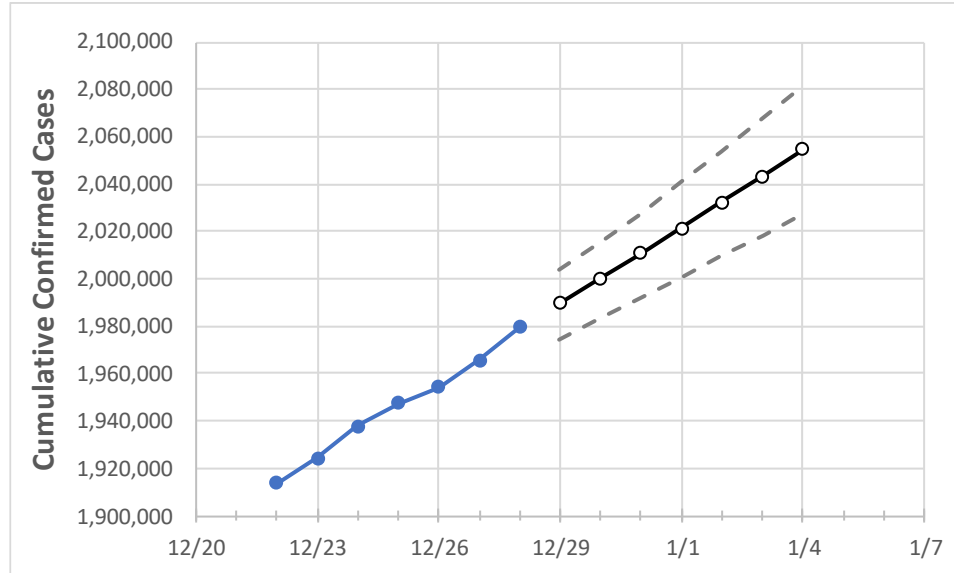
**IEM's Modeling Lead**

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:							
12/25	12/26	12/27	12/28	12/29	12/30	12/31	1/1	1/2	1/3	1/4	

Pennsylvania 1,947,649 1,954,488 1,965,567 1,979,510 1,989,575 2,000,206 2,010,900 2,021,580 2,032,464 2,043,386 2,054,698

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:							
	12/25	12/26	12/27	12/28	12/29	12/30	12/31	1/1	1/2	1/3	1/4	
Allegheny	168,486	169,372	169,781	170,435	171,182	171,958	172,739	173,505	174,301	175,107	175,931	
Berks	73,106	73,291	73,591	74,225	74,565	74,907	75,248	75,591	75,937	76,282	76,617	
Bucks	87,802	88,143	88,402	89,334	89,832	90,341	90,867	91,381	91,935	92,488	93,033	
Butler	31,902	31,970	32,037	32,136	32,225	32,306	32,391	32,477	32,562	32,646	32,730	
Chester	63,050	63,518	63,789	64,499	64,982	65,467	65,963	66,473	67,000	67,541	68,087	
Delaware	73,722	74,344	74,693	75,511	76,104	76,724	77,369	78,032	78,726	79,461	80,194	
Lackawanna	28,514	28,591	28,649	28,815	28,941	29,065	29,195	29,319	29,440	29,569	29,695	
Lancaster	87,649	87,975	88,314	88,840	89,253	89,676	90,086	90,511	90,933	91,369	91,803	
Lehigh	60,424	60,848	61,129	61,824	62,222	62,622	63,026	63,433	63,844	64,274	64,697	
Luzerne	51,422	51,602	51,724	51,953	52,147	52,338	52,527	52,714	52,899	53,092	53,276	
Monroe	24,774	24,992	25,125	25,322	25,479	25,633	25,797	25,957	26,125	26,291	26,466	
Montgomery	104,007	104,720	105,104	106,352	107,056	107,755	108,472	109,239	109,985	110,776	111,564	
Northampton	55,726	56,143	56,419	57,047	57,436	57,820	58,221	58,619	59,022	59,456	59,875	
Philadelphia	208,610	208,610	214,540	217,278	219,176	221,199	223,342	225,544	227,807	230,337	232,953	
Westmoreland	57,796	57,907	57,974	58,125	58,301	58,469	58,640	58,800	58,966	59,131	59,291	
York	82,094	82,434	82,924	83,474	84,141	84,783	85,442	86,141	86,842	87,540	88,303	

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:											
	12/25	12/26	12/27	12/28	12/30			1/1			1/3					
Allegheny	168,486	169,372	169,781	170,435	171,958	(34,392)	[8,254]	{4,127}	173,505	(34,701)	[8,328]	{4,164}	175,107	(35,021)	[8,405]	{4,203}
Berks	73,106	73,291	73,591	74,225	74,907	(14,981)	[3,596]	{1,798}	75,591	(15,118)	[3,628]	{1,814}	76,282	(15,256)	[3,662]	{1,831}
Bucks	87,802	88,143	88,402	89,334	90,341	(18,068)	[4,336]	{2,168}	91,381	(18,276)	[4,386]	{2,193}	92,488	(18,498)	[4,439]	{2,220}
Butler	31,902	31,970	32,037	32,136	32,306	(6,461)	[1,551]	{775}	32,477	(6,495)	[1,559]	{779}	32,646	(6,529)	[1,567]	{784}
Chester	63,050	63,518	63,789	64,499	65,467	(13,093)	[3,142]	{1,571}	66,473	(13,295)	[3,191]	{1,595}	67,541	(13,508)	[3,242]	{1,621}
Delaware	73,722	74,344	74,693	75,511	76,724	(15,345)	[3,683]	{1,841}	78,032	(15,606)	[3,746]	{1,873}	79,461	(15,892)	[3,814]	{1,907}
Lackawanna	28,514	28,591	28,649	28,815	29,065	(5,813)	[1,395]	{698}	29,319	(5,864)	[1,407]	{704}	29,569	(5,914)	[1,419]	{710}
Lancaster	87,649	87,975	88,314	88,840	89,676	(17,935)	[4,304]	{2,152}	90,511	(18,102)	[4,345]	{2,172}	91,369	(18,274)	[4,386]	{2,193}
Lehigh	60,424	60,848	61,129	61,824	62,622	(12,524)	[3,006]	{1,503}	63,433	(12,687)	[3,045]	{1,522}	64,274	(12,855)	[3,085]	{1,543}
Luzerne	51,422	51,602	51,724	51,953	52,338	(10,468)	[2,512]	{1,256}	52,714	(10,543)	[2,530]	{1,265}	53,092	(10,618)	[2,548]	{1,274}
Monroe	24,774	24,992	25,125	25,322	25,633	(5,127)	[1,230]	{615}	25,957	(5,191)	[1,246]	{623}	26,291	(5,258)	[1,262]	{631}
Montgomery	104,007	104,720	105,104	106,352	107,755	(21,551)	[5,172]	{2,586}	109,239	(21,848)	[5,243]	{2,622}	110,776	(22,155)	[5,317]	{2,659}
Northampton	55,726	56,143	56,419	57,047	57,820	(11,564)	[2,775]	{1,388}	58,619	(11,724)	[2,814]	{1,407}	59,456	(11,891)	[2,854]	{1,427}
Philadelphia	208,610	208,610	214,540	217,278	221,199	(44,240)	[10,618]	{5,309}	225,544	(45,109)	[10,826]	{5,413}	230,337	(46,067)	[11,056]	{5,528}
Westmoreland	57,796	57,907	57,974	58,125	58,469	(11,694)	[2,807]	{1,403}	58,800	(11,760)	[2,822]	{1,411}	59,131	(11,826)	[2,838]	{1,419}
York	82,094	82,434	82,924	83,474	84,783	(16,957)	[4,070]	{2,035}	86,141	(17,228)	[4,135]	{2,067}	87,540	(17,508)	[4,202]	{2,101}

For additional information from IEM, please contact Bryan Koon, Vice President of Emergency Management and Homeland Security at [bryan.koon@iem.com](mailto:bryan.koon@iem.com) or 850-519-7966 or Stephanie Tennyson at [stephanie.tennyson@iem.com](mailto:stephanie.tennyson@iem.com) or 202-309-4257.