

IEM's AI Modeling: Short-term COVID-19 Projections**Date: 12/29/20**

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 12/29/20 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.

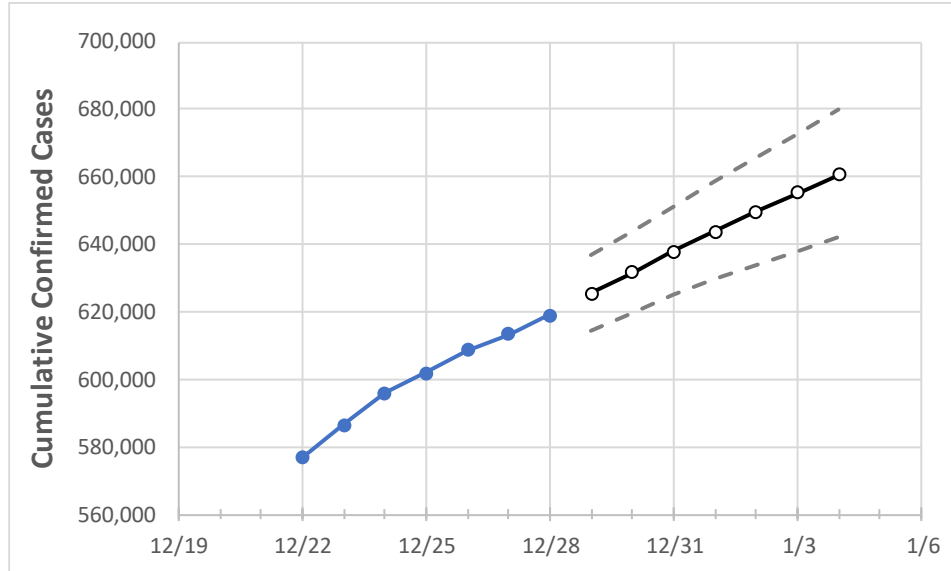
IEM's Modeling Lead

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	601,940	608,767	613,272	618,902	625,396	631,743	637,933	643,880	649,731	655,333	660,764

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 20%, and are often within 10%, 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	50,307	50,859	51,260	51,453	52,017	52,564	53,086	53,596	54,082	54,541	55,004
Berks	21,728	22,024	22,297	22,486	22,749	23,009	23,266	23,517	23,771	24,022	24,266
Bucks	28,538	28,831	29,033	29,244	29,535	29,816	30,096	30,371	30,633	30,894	31,148
Butler	8,481	8,635	8,716	8,760	8,883	9,004	9,121	9,236	9,351	9,463	9,570
Chester	18,572	18,749	18,927	19,104	19,296	19,481	19,661	19,839	20,013	20,183	20,346
Delaware	27,736	27,991	28,182	28,406	28,657	28,904	29,147	29,386	29,625	29,863	30,097
Lackawanna	8,052	8,189	8,301	8,370	8,500	8,627	8,760	8,895	9,026	9,160	9,297
Lancaster	26,307	26,557	26,727	26,957	27,237	27,512	27,778	28,049	28,311	28,559	28,815
Lehigh	18,843	19,071	19,280	19,449	19,712	19,965	20,217	20,470	20,715	20,963	21,208
Luzerne	16,022	16,285	16,437	16,511	16,661	16,807	16,948	17,077	17,204	17,328	17,451
Monroe	5,611	5,687	5,747	5,797	5,868	5,939	6,010	6,074	6,141	6,208	6,274
Montgomery	33,702	34,146	34,422	34,736	35,132	35,531	35,929	36,322	36,708	37,109	37,496
Northampton	15,460	15,679	15,779	15,893	16,100	16,307	16,507	16,711	16,914	17,109	17,301
Philadelphia	90,273	90,658	91,044	91,429	91,822	92,208	92,571	92,904	93,219	93,514	93,784
Westmoreland	17,989	18,131	18,298	18,389	18,567	18,730	18,893	19,052	19,190	19,327	19,459
York	21,477	21,837	22,088	22,293	22,595	22,896	23,192	23,491	23,781	24,064	24,353

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	50,307	50,859	51,260	51,453	52,564	(10,513)	[2,523]	{1,262}	53,596	(10,719)	[2,573]	{1,286}	54,541	(10,908)	[2,618]	{1,309}
Berks	21,728	22,024	22,297	22,486	23,009	(4,602)	[1,104]	{552}	23,517	(4,703)	[1,129]	{564}	24,022	(4,804)	[1,153]	{577}
Bucks	28,538	28,831	29,033	29,244	29,816	(5,963)	[1,431]	{716}	30,371	(6,074)	[1,458]	{729}	30,894	(6,179)	[1,483]	{741}
Butler	8,481	8,635	8,716	8,760	9,004	(1,801)	[432]	{216}	9,236	(1,847)	[443]	{222}	9,463	(1,893)	[454]	{227}
Chester	18,572	18,749	18,927	19,104	19,481	(3,896)	[935]	{468}	19,839	(3,968)	[952]	{476}	20,183	(4,037)	[969]	{484}
Delaware	27,736	27,991	28,182	28,406	28,904	(5,781)	[1,387]	{694}	29,386	(5,877)	[1,411]	{705}	29,863	(5,973)	[1,433]	{717}
Lackawanna	8,052	8,189	8,301	8,370	8,627	(1,725)	[414]	{207}	8,895	(1,779)	[427]	{213}	9,160	(1,832)	[440]	{220}
Lancaster	26,307	26,557	26,727	26,957	27,512	(5,502)	[1,321]	{660}	28,049	(5,610)	[1,346]	{673}	28,559	(5,712)	[1,371]	{685}
Lehigh	18,843	19,071	19,280	19,449	19,965	(3,993)	[958]	{479}	20,470	(4,094)	[983]	{491}	20,963	(4,193)	[1,006]	{503}
Luzerne	16,022	16,285	16,437	16,511	16,807	(3,361)	[807]	{403}	17,077	(3,415)	[820]	{410}	17,328	(3,466)	[832]	{416}
Monroe	5,611	5,687	5,747	5,797	5,939	(1,188)	[285]	{143}	6,074	(1,215)	[292]	{146}	6,208	(1,242)	[298]	{149}
Montgomery	33,702	34,146	34,422	34,736	35,531	(7,106)	[1,705]	{853}	36,322	(7,264)	[1,743]	{872}	37,109	(7,422)	[1,781]	{891}
Northampton	15,460	15,679	15,779	15,893	16,307	(3,261)	[783]	{391}	16,711	(3,342)	[802]	{401}	17,109	(3,422)	[821]	{411}
Philadelphia	90,273	90,658	91,044	91,429	92,208	(18,442)	[4,426]	{2,213}	92,904	(18,581)	[4,459]	{2,230}	93,514	(18,703)	[4,489]	{2,244}
Westmoreland	17,989	18,131	18,298	18,389	18,730	(3,746)	[899]	{450}	19,052	(3,810)	[914]	{457}	19,327	(3,865)	[928]	{464}
York	21,477	21,837	22,088	22,293	22,896	(4,579)	[1,099]	{549}	23,491	(4,698)	[1,128]	{564}	24,064	(4,813)	[1,155]	{578}

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.