

IEM's AI Modeling: Short-term COVID-19 Projections**Date: 10/22/21**

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 10/22/21 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.

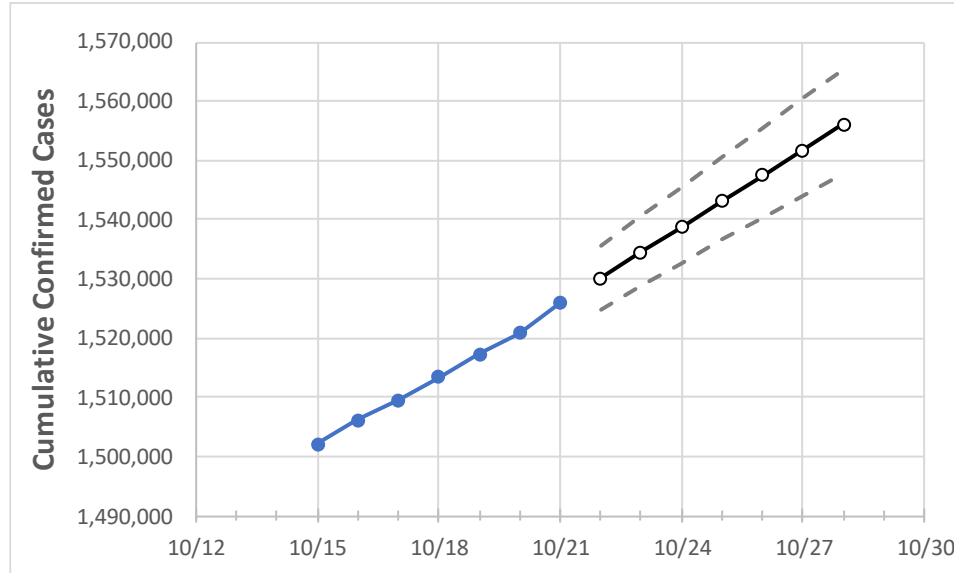
IEM's Modeling Lead

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:						
	10/18	10/19	10/20	10/21	10/22	10/23	10/24	10/25	10/26	10/27	10/28
Pennsylvania	1,513,332	1,517,231	1,520,815	1,525,813	1,530,084	1,534,487	1,538,783	1,543,144	1,547,423	1,551,803	1,556,173

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:							
	10/18	10/19	10/20	10/21	10/22	10/23	10/24	10/25	10/26	10/27	10/28	
Allegheny	127,983	128,202	128,478	128,955	129,325	129,696	130,066	130,443	130,808	131,178	131,553	
Berks	57,123	57,240	57,391	57,541	57,671	57,802	57,931	58,061	58,192	58,324	58,454	
Bucks	71,963	72,108	72,219	72,352	72,496	72,641	72,784	72,929	73,073	73,216	73,360	
Butler	24,327	24,366	24,421	24,515	24,596	24,677	24,755	24,827	24,907	24,983	25,059	
Chester	49,705	49,843	49,939	50,095	50,218	50,338	50,458	50,577	50,697	50,821	50,941	
Delaware	61,104	61,206	61,284	61,404	61,507	61,606	61,708	61,813	61,915	62,020	62,122	
Lackawanna	22,311	22,347	22,371	22,419	22,474	22,530	22,586	22,640	22,694	22,751	22,803	
Lancaster	69,535	69,689	69,901	70,127	70,329	70,529	70,725	70,927	71,126	71,324	71,522	
Lehigh	47,643	47,712	47,784	47,872	47,948	48,022	48,097	48,173	48,243	48,319	48,391	
Luzerne	39,750	39,828	39,943	40,078	40,209	40,338	40,461	40,589	40,716	40,842	40,970	
Monroe	19,174	19,227	19,260	19,339	19,391	19,443	19,494	19,545	19,595	19,646	19,699	
Montgomery	83,861	84,069	84,226	84,459	84,644	84,827	85,016	85,205	85,396	85,586	85,781	
Northampton	43,715	43,804	43,861	43,966	44,040	44,117	44,193	44,266	44,338	44,414	44,484	
Philadelphia	179,451	179,899	180,089	180,356	180,632	180,914	181,200	181,467	181,756	182,040	182,317	
Westmoreland	43,568	43,667	43,749	43,931	44,074	44,218	44,365	44,508	44,655	44,804	44,946	
York	60,259	60,440	60,631	60,866	61,081	61,293	61,504	61,717	61,930	62,143	62,356	

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:											
	10/18	10/19	10/20	10/21	10/23				10/25				10/27			
Allegheny	127,983	128,202	128,478	128,955	129,696	(25,939)	[6,225]	{3,113}	130,443	(26,089)	[6,261]	{3,131}	131,178	(26,236)	[6,297]	{3,148}
Berks	57,123	57,240	57,391	57,541	57,802	(11,560)	[2,774]	{1,387}	58,061	(11,612)	[2,787]	{1,393}	58,324	(11,665)	[2,800]	{1,400}
Bucks	71,963	72,108	72,219	72,352	72,641	(14,528)	[3,487]	{1,743}	72,929	(14,586)	[3,501]	{1,750}	73,216	(14,643)	[3,514]	{1,757}
Butler	24,327	24,366	24,421	24,515	24,677	(4,935)	[1,184]	{592}	24,827	(4,965)	[1,192]	{596}	24,983	(4,997)	[1,199]	{600}
Chester	49,705	49,843	49,939	50,095	50,338	(10,068)	[2,416]	{1,208}	50,577	(10,115)	[2,428]	{1,214}	50,821	(10,164)	[2,439]	{1,220}
Delaware	61,104	61,206	61,284	61,404	61,606	(12,321)	[2,957]	{1,479}	61,813	(12,363)	[2,967]	{1,484}	62,020	(12,404)	[2,977]	{1,488}
Lackawanna	22,311	22,347	22,371	22,419	22,530	(4,506)	[1,081]	{541}	22,640	(4,528)	[1,087]	{543}	22,751	(4,550)	[1,092]	{546}
Lancaster	69,535	69,689	69,901	70,127	70,529	(14,106)	[3,385]	{1,693}	70,927	(14,185)	[3,405]	{1,702}	71,324	(14,265)	[3,424]	{1,712}
Lehigh	47,643	47,712	47,784	47,872	48,022	(9,604)	[2,305]	{1,153}	48,173	(9,635)	[2,312]	{1,156}	48,319	(9,664)	[2,319]	{1,160}
Luzerne	39,750	39,828	39,943	40,078	40,338	(8,068)	[1,936]	{968}	40,589	(8,118)	[1,948]	{974}	40,842	(8,168)	[1,960]	{980}
Monroe	19,174	19,227	19,260	19,339	19,443	(3,889)	[933]	{467}	19,545	(3,909)	[938]	{469}	19,646	(3,929)	[943]	{471}
Montgomery	83,861	84,069	84,226	84,459	84,827	(16,965)	[4,072]	{2,036}	85,205	(17,041)	[4,090]	{2,045}	85,586	(17,117)	[4,108]	{2,054}
Northampton	43,715	43,804	43,861	43,966	44,117	(8,823)	[2,118]	{1,059}	44,266	(8,853)	[2,125]	{1,062}	44,414	(8,883)	[2,132]	{1,066}
Philadelphia	179,451	179,899	180,089	180,356	180,914	(36,183)	[8,684]	{4,342}	181,467	(36,293)	[8,710]	{4,355}	182,040	(36,408)	[8,738]	{4,369}
Westmoreland	43,568	43,667	43,749	43,931	44,218	(8,844)	[2,122]	{1,061}	44,508	(8,902)	[2,136]	{1,068}	44,804	(8,961)	[2,151]	{1,075}
York	60,259	60,440	60,631	60,866	61,293	(12,259)	[2,942]	{1,471}	61,717	(12,343)	[2,962]	{1,481}	62,143	(12,429)	[2,983]	{1,491}

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.