

IEM's AI Modeling: Short-term COVID-19 Projections**Date: 11/8/21**

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 11/8/21 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.

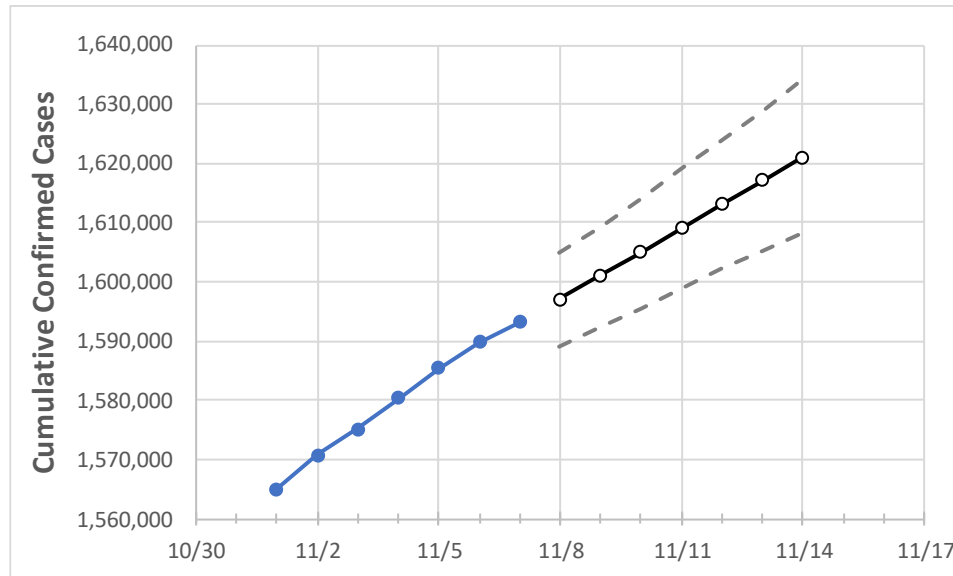
IEM's Modeling Lead

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:						
	11/4	11/5	11/6	11/7	11/8	11/9	11/10	11/11	11/12	11/13	11/14
Pennsylvania	1,580,346	1,585,476	1,589,737	1,593,122	1,597,088	1,601,091	1,605,053	1,609,116	1,613,124	1,617,230	1,621,094

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:						
	11/4	11/5	11/6	11/7	11/8	11/9	11/10	11/11	11/12	11/13	11/14
Allegheny	134,146	134,695	135,115	135,549	135,983	136,427	136,872	137,311	137,770	138,237	138,698
Berks	59,367	59,526	59,673	59,788	59,922	60,057	60,191	60,326	60,463	60,600	60,741
Bucks	74,113	74,298	74,475	74,606	74,748	74,891	75,033	75,180	75,324	75,473	75,620
Butler	25,560	25,696	25,801	25,881	25,971	26,060	26,151	26,246	26,340	26,435	26,533
Chester	51,421	51,542	51,542	51,542	51,637	51,732	51,829	51,924	52,022	52,117	52,212
Delaware	62,715	62,809	62,896	62,967	63,052	63,133	63,217	63,302	63,386	63,470	63,553
Lackawanna	23,034	23,106	23,165	23,221	23,276	23,332	23,389	23,445	23,503	23,560	23,622
Lancaster	72,429	72,597	72,814	72,989	73,154	73,318	73,481	73,641	73,808	73,971	74,136
Lehigh	48,932	48,991	49,078	49,157	49,237	49,314	49,391	49,470	49,548	49,627	49,706
Luzerne	41,581	41,718	41,844	41,963	42,073	42,186	42,297	42,408	42,521	42,635	42,745
Monroe	19,896	19,960	20,009	20,039	20,081	20,123	20,162	20,204	20,246	20,287	20,329
Montgomery	86,545	86,694	86,853	87,019	87,162	87,306	87,449	87,594	87,733	87,877	88,022
Northampton	44,996	45,082	45,199	45,260	45,338	45,414	45,493	45,574	45,654	45,733	45,813
Philadelphia	183,119	183,308	183,308	183,308	183,475	183,639	183,809	183,963	184,127	184,285	184,448
Westmoreland	45,819	45,983	46,127	46,245	46,379	46,520	46,656	46,793	46,934	47,072	47,207
York	63,629	63,889	64,107	64,259	64,448	64,644	64,832	65,023	65,211	65,403	65,594

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:											
	11/4	11/5	11/6	11/7	11/9			11/11			11/13					
Allegheny	134,146	134,695	135,115	135,549	136,427	(27,285)	[6,548]	{3,274}	137,311	(27,462)	[6,591]	{3,295}	138,237	(27,647)	[6,635]	{3,318}
Berks	59,367	59,526	59,673	59,788	60,057	(12,011)	[2,883]	{1,441}	60,326	(12,065)	[2,896]	{1,448}	60,600	(12,120)	[2,909]	{1,454}
Bucks	74,113	74,298	74,475	74,606	74,891	(14,978)	[3,595]	{1,797}	75,180	(15,036)	[3,609]	{1,804}	75,473	(15,095)	[3,623]	{1,811}
Butler	25,560	25,696	25,801	25,881	26,060	(5,212)	[1,251]	{625}	26,246	(5,249)	[1,260]	{630}	26,435	(5,287)	[1,269]	{634}
Chester	51,421	51,542	51,542	51,542	51,732	(10,346)	[2,483]	{1,242}	51,924	(10,385)	[2,492]	{1,246}	52,117	(10,423)	[2,502]	{1,251}
Delaware	62,715	62,809	62,896	62,967	63,133	(12,627)	[3,030]	{1,515}	63,302	(12,660)	[3,039]	{1,519}	63,470	(12,694)	[3,047]	{1,523}
Lackawanna	23,034	23,106	23,165	23,221	23,332	(4,666)	[1,120]	{560}	23,445	(4,689)	[1,125]	{563}	23,560	(4,712)	[1,131]	{565}
Lancaster	72,429	72,597	72,814	72,989	73,318	(14,664)	[3,519]	{1,760}	73,641	(14,728)	[3,535]	{1,767}	73,971	(14,794)	[3,551]	{1,775}
Lehigh	48,932	48,991	49,078	49,157	49,314	(9,863)	[2,367]	{1,184}	49,470	(9,894)	[2,375]	{1,187}	49,627	(9,925)	[2,382]	{1,191}
Luzerne	41,581	41,718	41,844	41,963	42,186	(8,437)	[2,025]	{1,012}	42,408	(8,482)	[2,036]	{1,018}	42,635	(8,527)	[2,046]	{1,023}
Monroe	19,896	19,960	20,009	20,039	20,123	(4,025)	[966]	{483}	20,204	(4,041)	[970]	{485}	20,287	(4,057)	[974]	{487}
Montgomery	86,545	86,694	86,853	87,019	87,306	(17,461)	[4,191]	{2,095}	87,594	(17,519)	[4,205]	{2,102}	87,877	(17,575)	[4,218]	{2,109}
Northampton	44,996	45,082	45,199	45,260	45,414	(9,083)	[2,180]	{1,090}	45,574	(9,115)	[2,188]	{1,094}	45,733	(9,147)	[2,195]	{1,098}
Philadelphia	183,119	183,308	183,308	183,308	183,639	(36,728)	[8,815]	{4,407}	183,963	(36,793)	[8,830]	{4,415}	184,285	(36,857)	[8,846]	{4,423}
Westmoreland	45,819	45,983	46,127	46,245	46,520	(9,304)	[2,233]	{1,116}	46,793	(9,359)	[2,246]	{1,123}	47,072	(9,414)	[2,259]	{1,130}
York	63,629	63,889	64,107	64,259	64,644	(12,929)	[3,103]	{1,551}	65,023	(13,005)	[3,121]	{1,561}	65,403	(13,081)	[3,139]	{1,570}

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.